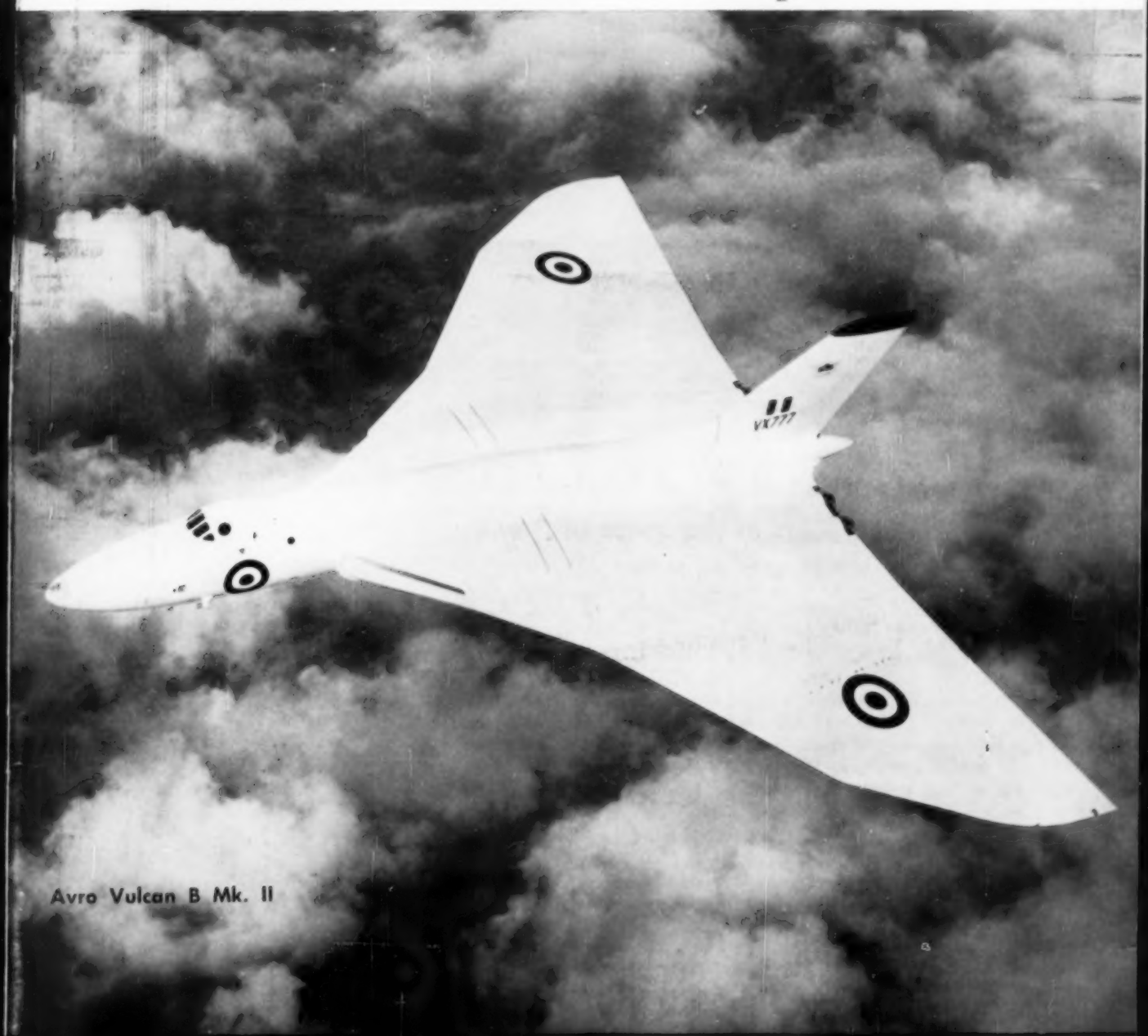
AVIATION WEEK

A McGRAW-HILL PUBLICATION

October 14, 1957 75 cents

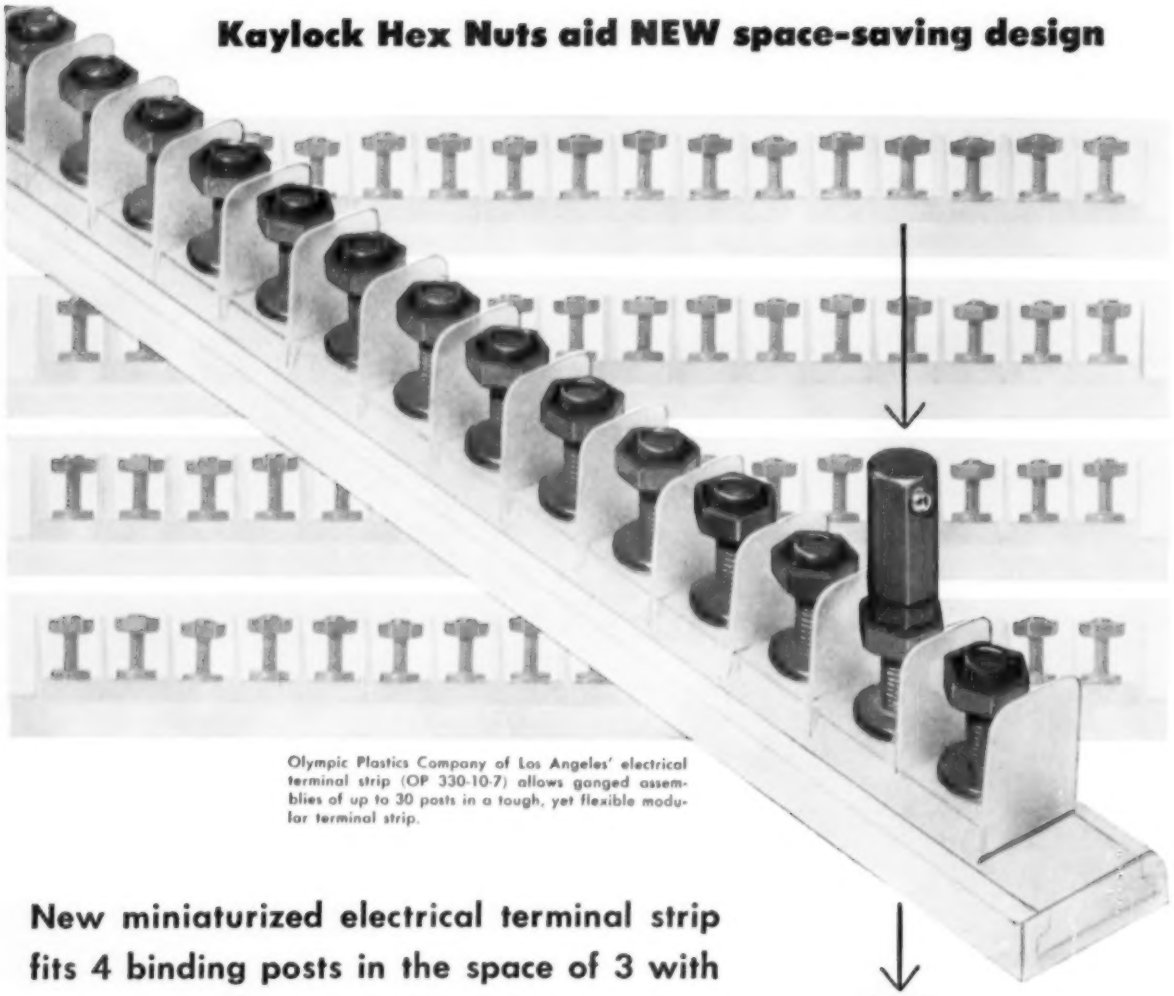
Man Reaches 95 Mi. Simulated Altitude In Vacuum Chamber



Avro Vulcan B Mk. II

TWA Analyzes Jet Costs, Operations

Kaylock Hex Nuts aid NEW space-saving design



Olympic Plastics Company of Los Angeles' electrical terminal strip (OP 330-10-7) allows ganged assemblies of up to 30 posts in a tough, yet flexible modular terminal strip.

New miniaturized electrical terminal strip fits 4 binding posts in the space of 3 with

KAYLOCK
All-metal self-locking nuts ®

INTERNAL/external wrenching Hex Nuts

This new lightweight modular terminal strip was designed with KAYLOCK self-locking Hex Nuts in mind. The internal wrenching feature of the nut permits a close coupled assembly more compact than ever before practical. The result is a saving of 25% in length and 10% in weight. Lockheed Aircraft Corp. in cooperation with Olympic Plastics Co. designed this new terminal strip for the aircraft and electronics industries.

INTERNAL/external wrenching—

- **Reduces counterbore and spotface diameters**
- **Eliminates wrench damage to surrounding material**
- **Reduces weight and space**

KAYLOCK Hex Nuts, available in steel or corrosion-resistant steel, conform to all three Air Force-Navy standards: AN363, AN364, AN365, and the new low height National Aircraft Standard NAS679.

Catalog available on request.

THE KAYNAR COMPANY—KAYLOCK DIVISION, DEPT. EC, BOX 2001, TERMINAL ANNEX, LOS ANGELES 54, CALIFORNIA ©1957

Canadian Distributor: Abercorn Aero Ltd., Montreal, Quebec

What does it take to create a complete

Missile Weapon System?

WEAPON SYSTEM: A definition

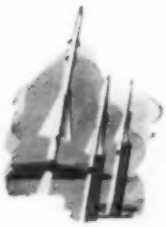
"A system composed of equipment, skills and techniques, the composite of which forms an instrument of combat, usually . . . having an air vehicle as its major operational element. The complete weapon system includes all related equipment, materials, services, and personnel required solely for the operation of the air vehicle . . . so that the instrument of combat becomes a self-sufficient unit of striking power within its intended operational environment."
— Quoted from Defense Department Regulations

GUIDANCE
— of the accuracy of ATRAN. Goodyear Aircraft Corporation designed, developed and produces this system for guiding American missiles.

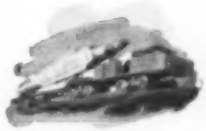
RADOMES
— exterior structural plastic housing for a missile's electronic eyes. Goodyear Aircraft is a pioneer and leading producer of such housings.

RADAR
— Goodyear Aircraft builds hi-performance airborne systems and large radar structures for early warning, missile guidance and tracking systems.

AIRFRAMES
— fabricated of the newest alloys by the most advanced techniques. Goodyear Aircraft has decades of light-metals experience in airship pioneering, building thousands of complete airplanes and structures for today's jet aircraft and missiles.



ROCKETS
— to propel the missiles skyward. Goodyear Aircraft builds more large-size rocket cases than any other manufacturer, has one of the largest facilities in the nation.



GROUND SUPPORT EQUIPMENT
— to check the missile's design characteristics, the complete system's performance—to move, maintain, launch a squadron's missiles. Goodyear Aircraft designs and builds this equipment, and has created today's foremost mobile missile ground support system.

COMPUTERS AND FLIGHT SIMULATORS
— to check the missile's initial design characteristics and simulate its flight. Goodyear Aircraft builds GEDA, an analog computer, and supplies flight simulators for the military services.

UNIFIED ENGINEERING
— to solve the technical complexities of creating a complete system. Goodyear Aircraft has a Weapon System Engineering organization—specialists with a unified approach to, and complete familiarity with, the total problem.

PRODUCTION FACILITIES
— to tie together and produce the whole concept. Goodyear Aircraft maintains facilities in Akron, Ohio, and Litchfield Park, Arizona, where 12,000 skilled people work—*To Keep America First In The Air.*

They Have What It Takes at

GOODYEAR AIRCRAFT

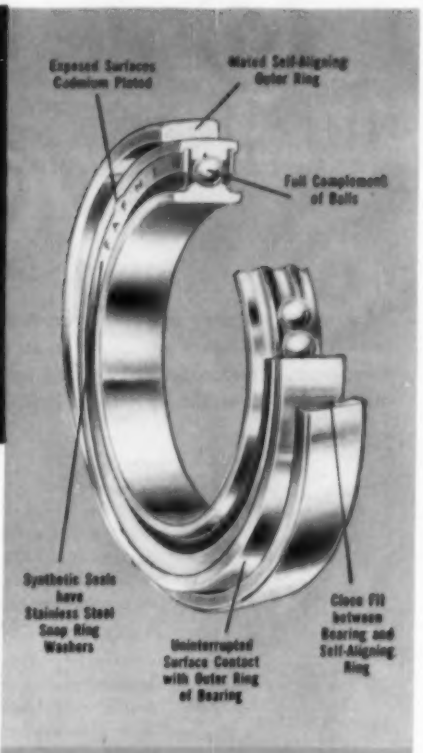
Plants in Akron, Ohio, and Litchfield Park, Arizona · Rewarding Challenges and Careers for Engineers

ATRAN, GEDA – T. M.'s Goodyear Aircraft Corporation, Akron 15, Ohio

How to keep controls and costs "in line"!

FAFNIR Torque Tube Type Aircraft Control Bearing

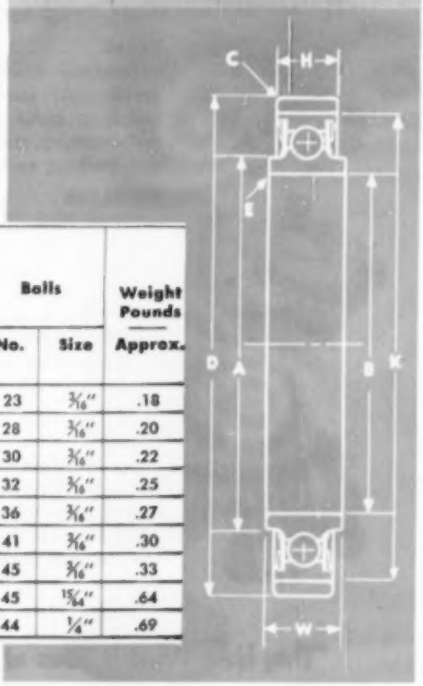
with Self-Aligning Outer Ring


Exposed Surfaces Cadmium Plated
Mated Self-Aligning Outer Ring
Full Complement of Balls
Synthetic Seals have Stainless Steel Snap Ring Washers
Uninterrupted Surface Contact with Outer Ring of Bearing
Close Fit between Bearing and Self-Aligning Ring

Design, assembly, and inspection of push-pull control systems are simplified considerably when Fafnir KP-BS Torque Tube Type Control Bearings are specified.

Developed to accommodate structural deflection, manufacturing errors, and differential expansion and contraction in high-speed aircraft, KP-BS bearings feature a self-aligning outer ring. This eliminates the need for extra parts to achieve and maintain correct bearing alignment in housings. Thus these bearings make possible important savings in space, weight, assembly time, and costs.

An adaptation of the AN202 KP-B series, Fafnir Self-Aligning Torque Tube Type Ball Bearings have the same high capacity as the rigid KP-B Type. The close fit between the self-aligning ring and the bearing provides the necessary rigidity for control systems. For detailed specifications, write The Fafnir Bearing Company, New Britain, Conn.



AVAILABLE SIZES AND DIMENSIONS

Bearing Number	B	D	W	H	A	E	C	K	Balls		Weight Pounds
	Bore +.0000 −.0010	Outside Diam. +.0000 −.0010	Width Inner Ring +.000 −.005	Width Outer Ring +.000 −.005	Shoulder Diam. Inner Ring (Approx.)	Corner Rad. Cleared: Inner Ring Bore	Corner Rad. Cleared: Outer Ring O.D.	To Corner (Ref.)	No.	Size	Approx.
	Inches	Inches	Inches	Inches	Inches	Inches					
KP16BS	1.0000*	1.9375	.437	.375	1.141	.024	.024	1.709	23	3/16"	.18
KP21BS	1.3130	2.2500	.437	.375	1.454	.024	.024	2.028	28	3/16"	.20
KP23BS	1.4380	2.3750	.437	.375	1.575	.024	.024	2.155	30	3/16"	.22
KP25BS	1.5630	2.5000	.437	.375	1.693	.024	.024	2.282	32	3/16"	.25
KP29BS	1.8130	2.7500	.437	.375	1.931	.024	.024	2.535	36	3/16"	.27
KP33BS	2.0630	3.0000	.437	.375	2.231	.024	.024	2.787	41	3/16"	.30
KP37BS	2.3130	3.2500	.437	.375	2.468	.024	.024	3.039	45	3/16"	.33
KP47BS	2.9380	4.1250	.531	.469	3.093	.039	.039	3.846	45	15/64"	.64
KP49BS	3.0630	4.2500	.531	.469	3.222	.039	.039	3.972	44	1/4"	.69

*+.0000 −.0005

Bearings incorporate Fafnir Flya-Seals and are pre-lubricated at the factory.

FAFNIR AIRCRAFT BEARINGS

FIRST...at the turning points in aircraft design

AVIATION CALENDAR

Oct. 16—Constant Speed Drive Development, AIEE Engineers Club, Philadelphia, Pa.

Oct. 16-18—Conference on Computers in Control, American Institute of Electrical Engineers, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Oct. 16-18—1957 IRE Canadian Convention, Automotive Building, Exhibition Park, Toronto, Ont., Canada.

Oct. 17-18—13th Annual Convention, The Magnesium Assn., Biltmore Hotel, N. Y.

Oct. 17-18—National Conference on Industrial Hydraulics (including use in airline systems). Hotel Sherman, Chicago.

Oct. 18—Some Aspects of the National Guided Missile Program, Vice Adm. John S. Sides, Dinner Meeting, American Rocket Society and Institute of the Aeronautical Sciences, Sheraton-McAlpin Hotel, N. Y. C.

Oct. 20-22—American Helicopter Society, Fourth Annual Western Forum, Hotel Statler, St. Louis, Mo.

Oct. 21-22—Canadian Aeronautical Institute—Institute of the Aeronautical Sciences Meeting, Montreal, Canada.

Oct. 21-23—Conference on New Developments in the Field of Power, American Society of Mechanical Engineers, Americus Hotel, Allentown, Pa.

Oct. 21-25—45th National Safety Congress, Conrad Hilton Hotel, Chicago.

Oct. 22—Third World Conference for Aviation, month-long meeting on tariffs, cargo, etc., Sao Paulo, Brazil.

Oct. 24-25—Fourteenth Annual Display, Aircraft Electrical Equipment, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles.

Oct. 24-25—Computer Applications Symposium, Morrison Hotel, Chicago, sponsored by Armour Research Foundation of Illinois Institute of Technology.

Oct. 28-29—Third Annual Meeting, Association of the U. S. Army, Sheraton-Park Hotel, Washington, D. C.

(Continued on page 6)

AVIATION WEEK • OCTOBER 14, 1957

Vol. 67, No. 15

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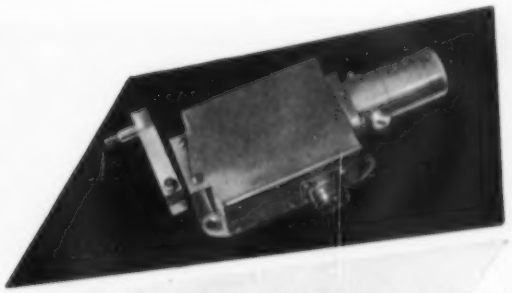
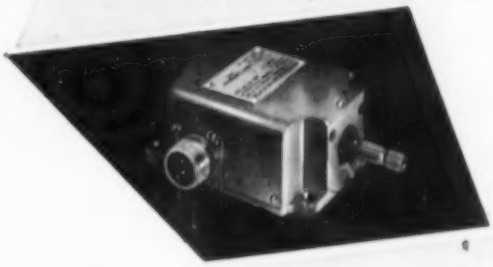


The rotary actuator above incorporates an electrically operated clutch which will permit either free rotation of the crank, or will engage the motor and gear train to drive the crank.

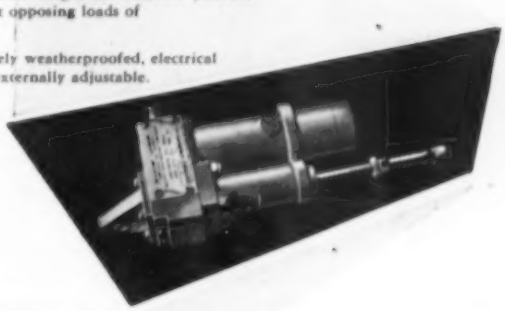
A built-in damper of the newly adapted eddy current principle resists input forces in proportion to input speeds when the crank is de-clutched and free to rotate.

This unique damper is also used in the magnetic brake below. The input shaft becomes locked to resist torque up to 200 inch-pounds when the brake is electrically de-energized. When the brake is energized, the input shaft is unlocked and the damper controls the input forces.



The linear actuator below, was designed and built to provide reliable electrical actuation in an environment of violent centrifuging and vibration. This unit weighs *less* than *1.5 pounds*, yet is capable of operating against opposing loads of *over 100 times* its own weight.

Although this actuator is completely weatherproofed, electrical and mechanical travel limits are externally adjustable.



Lyndon's ability to innovate *— to overcome routine engineering habits — results in the development of products which more precisely fit the requirements of your application.*

If you are in aircraft or missile design stages requiring electrical, pneumatic or hydraulic controls and systems, Lyndon is ready to help you.

LYNDON AIRCRAFT, Inc.

Subsidiary of **SCOVILL MANUFACTURING COMPANY**

West Coast — ROBERT W. SMITH, sales manager, 8350 Wilshire Boulevard, Beverly Hills, California

San Diego — R. M. BRUNSON & ASSOCIATES, 132 North Acacia Avenue, Solana Beach, California

East Coast — LYNDON AIRCRAFT, inc., 140 A Clifford Street, Newark 5, New Jersey

THESE ARE THE MEN OF

CLEMCO

AERO PRODUCTS, INC.

Furnishing leadership in the field of aircraft and guided missiles for the world today ... for the universe tomorrow

BERNARD E. O'CONNOR
Director of Engineering
The inventor of forty-nine U.S. patents and patents pending in the field of hydraulics and dynamics. Developer of design criteria for original application of Flutter Dampers to surface control of aircraft. Nationally recognized authority in aircraft and missile field. Author of numerous articles on hydraulics and dynamics.

ROBERT E. MARSH
Plant Manager
Came to Clemco from former position of Factory Manager of Aircraft Division of Houdaille-Hershey Corporation of Buffalo. Long record of engineering and executive posts with major aircraft companies.

AL COPPULA
Manager, Quality Control
Thirty-three years in aircraft industry in key positions, including seventeen years with Air Force as Quality Control Representative in major aircraft plants. Past affiliations include Boeing, Consolidated Vultee, and Southern California Aircraft Corporation.

RICHARD H. FARNEY
Contract Administrator
Brings many years of active aviation industry leadership to Clemco. Co-owner of Farney-Shaw Machine works, owner of Fasco Machine Shop, General Manager of Fabco, Inc., and General Superintendent of Lockheed Aircraft among important past positions.

R. U. ENGELHARDT
Manager, Customer Liason
Almost twenty years executive experience in engineering, production, sales, and customer liason work throughout the United States.

R. GLENN GORMAN
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Well known throughout the aircraft and missile manufacturing industry for his leadership in developing many products which are in common use today. Long record of executive and administrative experience in many manufacturing fields throughout nation.

JOHN D. TAYLOR
President
An active leader in many industrial and business enterprises in the U.S., Mr. Taylor's continued consultation with Clemco executive personnel allows him to contribute his leadership and experience to the everyday operation of Clemco.

JOE JOYCE
President
Jo-Joyce Engineering Sales Corp.
Sales representative for Clemco Aero Products west of the Mississippi. Well known and highly respected throughout the aircraft industry of the U.S. for his creative sales-engineering ability.

CLEMCO AERO PRODUCTS, INC. are furnishing the leaders of the aircraft and missile industry with the following:

ROTARY ACTUATORS
POWER STEERING UNITS
FLUTTER DAMPERS
MISSILE FINS AND SPARS

PROPRIETARY DESIGNS OF HYDRAULIC AND PNEUMATIC UNITS FOR MILITARY AND COMMERCIAL AIRCRAFT, AND MISSILES

CAP

Write for complete Clemco folder to

CLEMCO
AERO PRODUCTS, INC.
210 E. Manville St., Compton, California

This is #1 of a continuing series of advertisements prepared especially for the advancement of the aircraft industry by CLEMCO. Keep a file of them so you will have the complete story of CLEMCO.

AVIATION CALENDAR

(Continued from page 5)

Oct. 28-29—First National Conference on Applied Meteorology, Hotel Statler, Hartford, Conn.

Oct. 28-30—Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md.

Oct. 28-31—Second Winter Meeting, American Nuclear Society, Henry Hudson Hotel, New York.

Oct. 28-31—National Industrial Packaging & Handling Exposition, Atlantic City Convention Hall, N. J.

Oct. 30-Nov. 1—Annual Meeting, Air Traffic Control Assn., CAA Technical Development Center, Indianapolis, Ind.

Oct. 30—Aviation Electrical Equipment Display, U. S. Grant Hotel, San Diego.

Oct. 31-Nov. 1—Fourth Annual Meeting, Professional Group on Nuclear Science, Henry Hudson Hotel, New York.

Nov. 1-3—Dallas Air Fair, sponsored by the Dallas Junior Chamber of Commerce, Addison Airport, Dallas, Tex.

Nov. 2-8—Second World Metallurgical Congress & 39th National Metal Exposition & Congress, Palmer House, Hotel Sherman and International Amphitheatre, Chicago.

Nov. 4-8—Fourth Institute on Electronics in Management (automatic data processing system), The American University, 1901 F St., Washington 6, D. C.

Nov. 5-7—Joint Military-Industry Guided Missile, Reliability Symposium (limited to those with Secret security clearance), Naval Air Missile Test Center, Pt. Mugu, Calif.

Nov. 11—Plastics for Airborne Electronics, Regional Technical Conference, Society of Plastics Engineers, Hotel Ambassador, Los Angeles.

Nov. 11-13—Third IRE Instrumentation Conference and Exhibit (Data Handling), Atlanta Biltmore Hotel, Atlanta, Ga.

Nov. 11-15—1957 International Air Safety Seminar, Flight Safety Foundation, Palo Alto, Calif. FSF-Aviation Week Safety Awards Dinner, Nov. 14. For Details write FSF, 468 Fourth Ave., N. Y. C.

Nov. 12-13—Seventh Aircraft Hydraulics Conference, Park Shelton Hotel, Detroit, sponsored by Vickers Inc. (invitation only).

Nov. 13-14—Mid-America Electronics Convention, Municipal Auditorium, Kansas City, Mo.

Nov. 13-15—18th Annual Convention, National Aviation Trades Assn., Hotel Adolphus, Dallas.

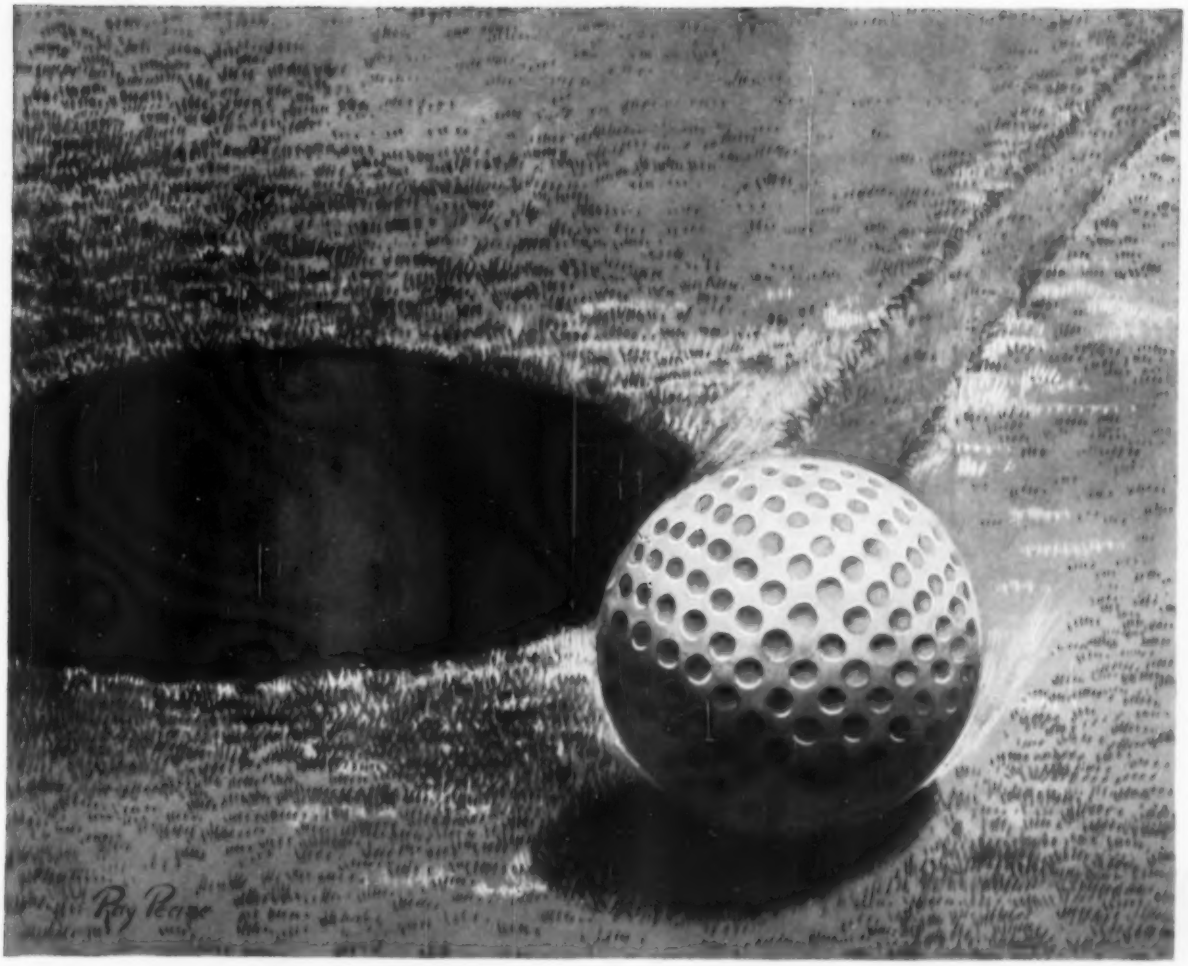
Nov. 17-21—Eighth National Plastics Exposition, International Amphitheater, Chicago.

Nov. 18-29—Technical Conference, International Air Transport Assn., Miami, Fla.

Nov. 20-22—30th Meeting, Aviation Distributors and Manufacturers Assn., Sheraton-Cadillac Hotel, Detroit.

Dec. 4-5—Symposium on high temperature strain gages, Aeronautical Structures Laboratory, Naval Air Material Center, Philadelphia 12, Pa.

Dec. 9-13—1957 Eastern Joint Computer Conference and Exhibit, Sheraton Park Hotel, Washington, D. C.



All it takes is practice!

When that ball skims the edge of the cup, you can blame wind, weather, putter, green, your wife's cooking, or a fleeting conflict of ego and libido. But when the shot is sunk, you can credit experience, practice and knowledge of the course. It's the same with titanium.

Titanium can be readily forged, machined, welded, stretched and drawn into shapes having high strength, light weight and superlative resistance to both heat and corrosion. Titanium fabricating, joining and finishing practices are no more difficult than for many other engineering metals, but they are different.

TMCA has accumulated a great deal of pertinent experience and practical data which are available to you on request. Extensive research facilities can also expedite special investigations to answer your specific questions.

TMCA has a selfish reason for helping you "sink the shot" whenever a technical challenge arises. Our Technical Service Department is anxious to discuss your application and cooperate in the establishment of routine fabricating and joining techniques for this outstanding engineering metal . . . now priced competitively.

. . . FIRST IN Titanium

TITANIUM METALS CORPORATION OF AMERICA, 233 Broadway, New York 7, N.Y.

IN ANY ATTITUDE
THE F-105

Streaking skyward or racing along "on the deck" . . . able to intercept or retaliate against an aggressor with powerful agility . . . the new Republic F-105 Thunderchief fighter-bomber brings to the United States Air Force a devastating weapon for defense.

REPUBLIC AVIATION

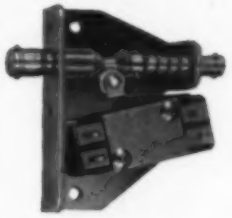
FARMINGDALE, LONG ISLAND, N. Y.

THUNDER-CRAFT

TYPICAL ELECTRO-SNAP INTERLOCKS

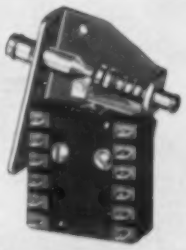
Push to operate;
returns automatically.

Pull to operate;
remains in operating position until reset for automatic return by next full-stroke push operation.

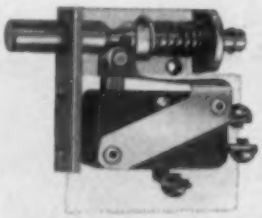


MODEL C2-4 S.P.D.T. 2 ckts. **Elec. rating:** 125/250 V.A.C., 30 V.D.C. –10 amps. 125 V.D.C., ½ amp. 250 V.D.C., ¼ amp. **Oper. force:** 2 lbs. ± 12 oz. **Weight:** 2 oz. **Dimensions:** 1-13/16" x 1-31/32" x 9/16"

MODEL C2-9 D.P.D.T. **Elec. rating:** 15 amp. 125/250 V.A.C. 60 cycle. **Oper. force:** 4¾ lbs. ± 12 oz. **Amb. temp:** –100° to + 275° F. **Elec. & Mech. Life:** 150,000 ops. **Weight:** 2 oz. approx. **Dimensions:** 1-29/32" x 1-31/32" x 9/16"

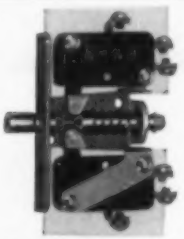


MODEL C2-14 T.P.D.T., 6 ckt. **Pre-travel:** 5/32" min. **Overtravel:** ¼" approx. **Mov. Diff.** .028" ± .007" **Elec. ratings:** 15 amp. 125/250 V.-A.C.–15 amp. 30 V.D.C., res.–10 amp. 30 V.D.C., ind. **Life**–500,000 ops. min. **Dimensions:** 2-5/16" x 1-31/32" x 9/16"



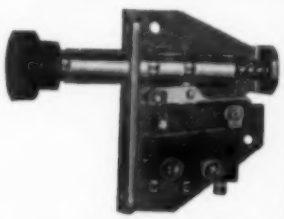
MODEL C2-5 Solid shaft. S.P.D.T. **Elec. rating:** 10 amps. @ 125/250 V.A.C., 60 cycles. **Oper. force:** 2 lbs. ± 12 oz. **Amb. temp.:** –100° to + 275° F. **Elec. & Mech. life:** 150,000 ops. **Weight:** 2 oz. **Dimensions:** 1-13/16" x 1⅞" x ½"

MODEL C2-10 same as C2-5, except has threaded shaft.

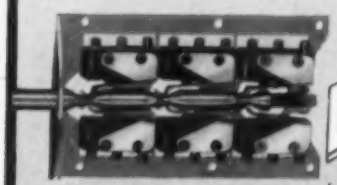


MODEL C2-7 Solid shaft. D.P.D.T. **Pre-travel:** 3/16" max. **Elec. rating:** 10 amp. 125/250 V.A.C. 60 cycle. **Amb. temp.:** –100° to + 275° F. **Elec. & Mech. Life:** 150,000 ops. **Dimensions:** 2-3/32" x 1⅞" x 33/64"

MODEL C2-6 same as C2-7, except has threaded shaft.



MODEL C2-15–Subminiature Interlock. S.P.D.T.; **Elec. & Mech. Life and Rating:** 150,000 ops. @ 2.5 Amps., 125/250 V.A.C.; 100,000 ops. @ 5 amps, 125/250 V.A.C. **Dimensions:** 1-13/16" x 1¼" x 9/16". Various colored buttons available.
(Also available in momentary contact, one-way impulse action.)



GANGED INTERLOCKS–2 or more switches may be ganged for multiple control with single actuation.

how to cut control costs

with no sacrifice in switch reliability!

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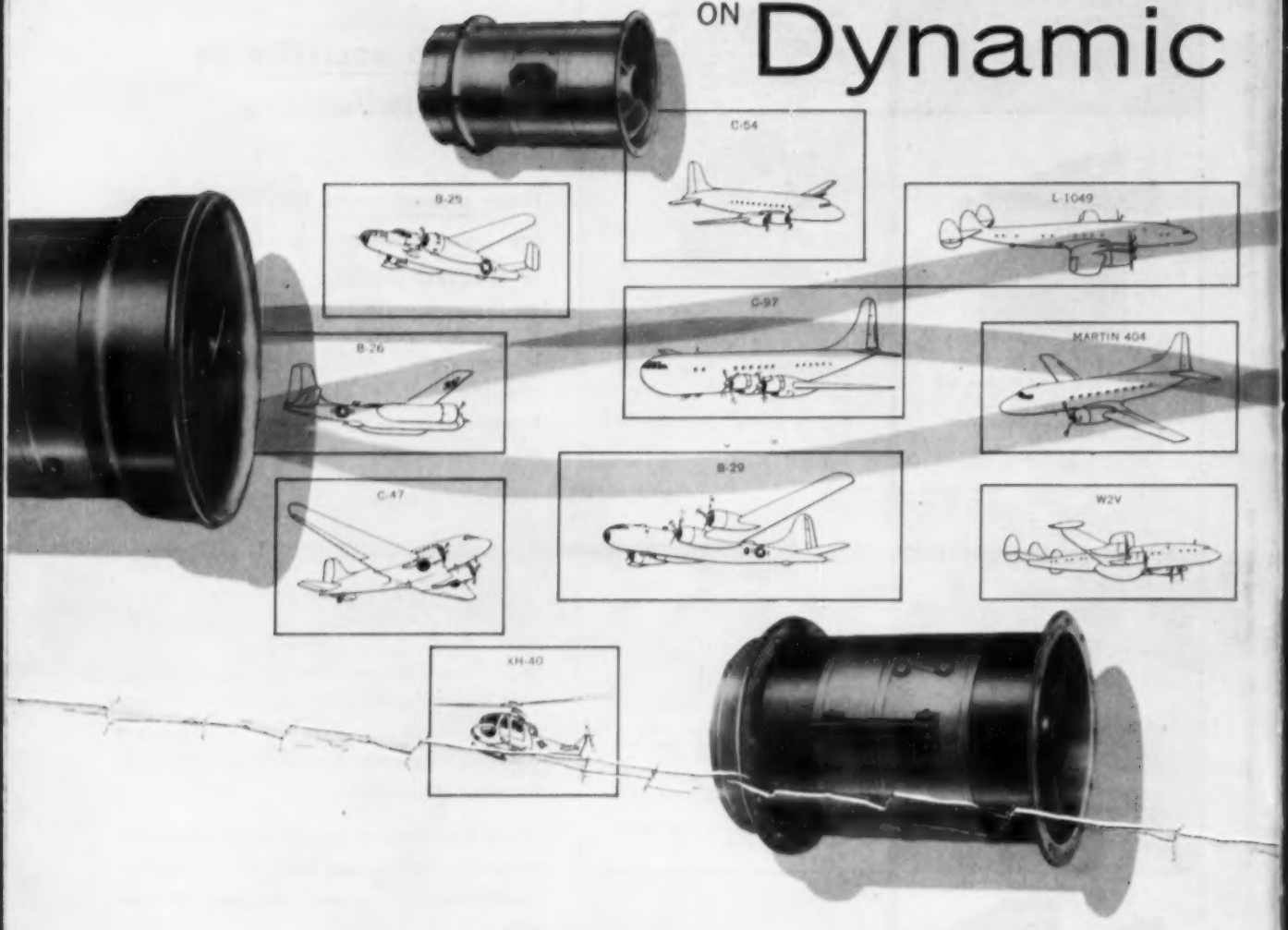

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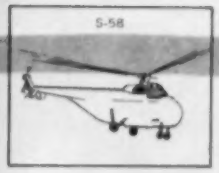

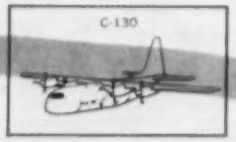

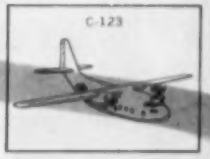

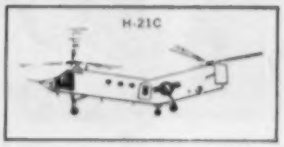

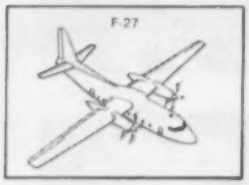

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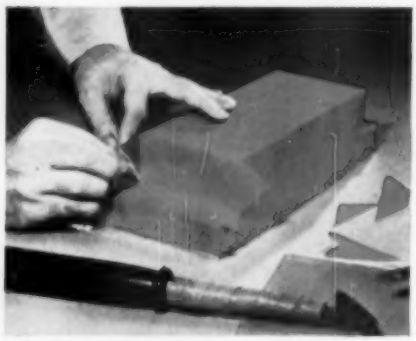
STEP 1
Pre-impregnated glass cloth is hand tailored to a form. The form can be made of metal, plaster, or any heat-stable material. Where necessary, the cloth is tacked in place with a sealing iron. The pre-impregnated cloth has good drape and can be used to make complex parts.

STEP 2
The lay-up is surrounded by bleeder cloth, which allows even distribution of the vacuum.

STEP 3
The covered lay-up is placed in a PVA bag, and a vacuum drawn on the bag with a mechanical pump. The bag is then sealed, and the whole assembly placed in an oven. The part is cured through 350 F.

STEP 4
Following the initial cure, the bag and bleeder cloth are removed. The part is then afterbaked through 480 F, trimmed, and finished. Complete operation is simple and economical.



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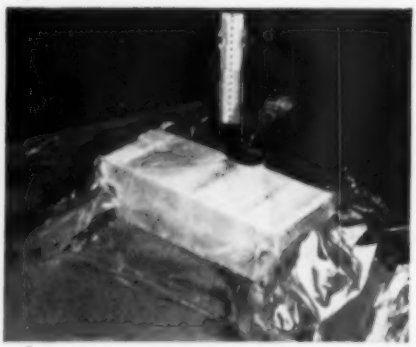

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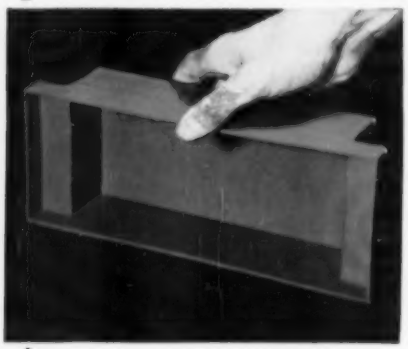

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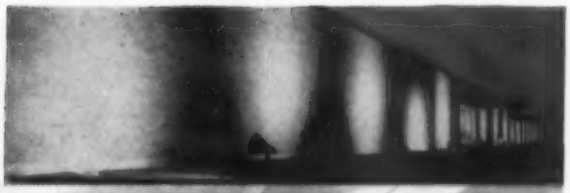

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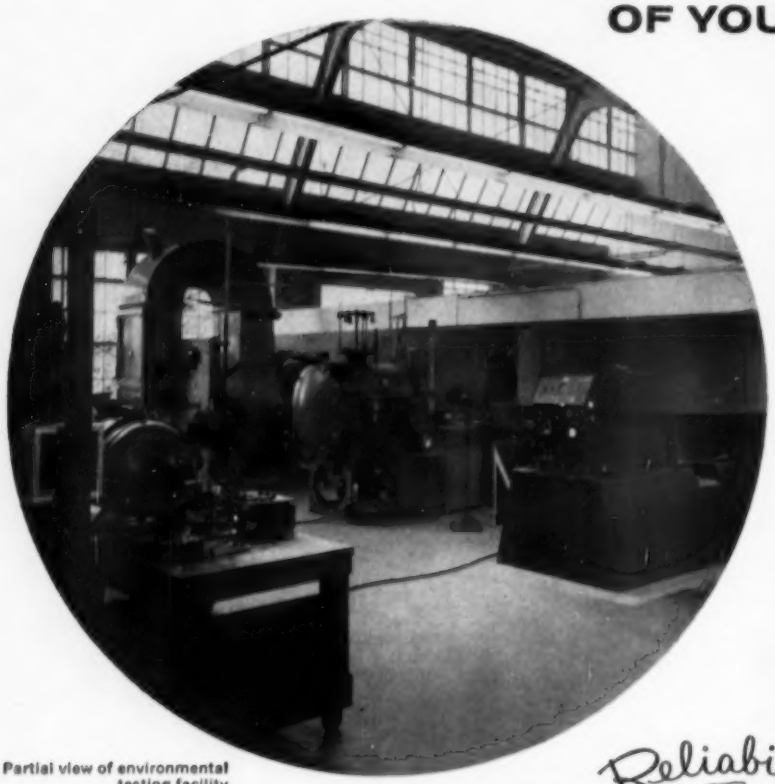

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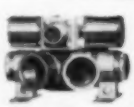

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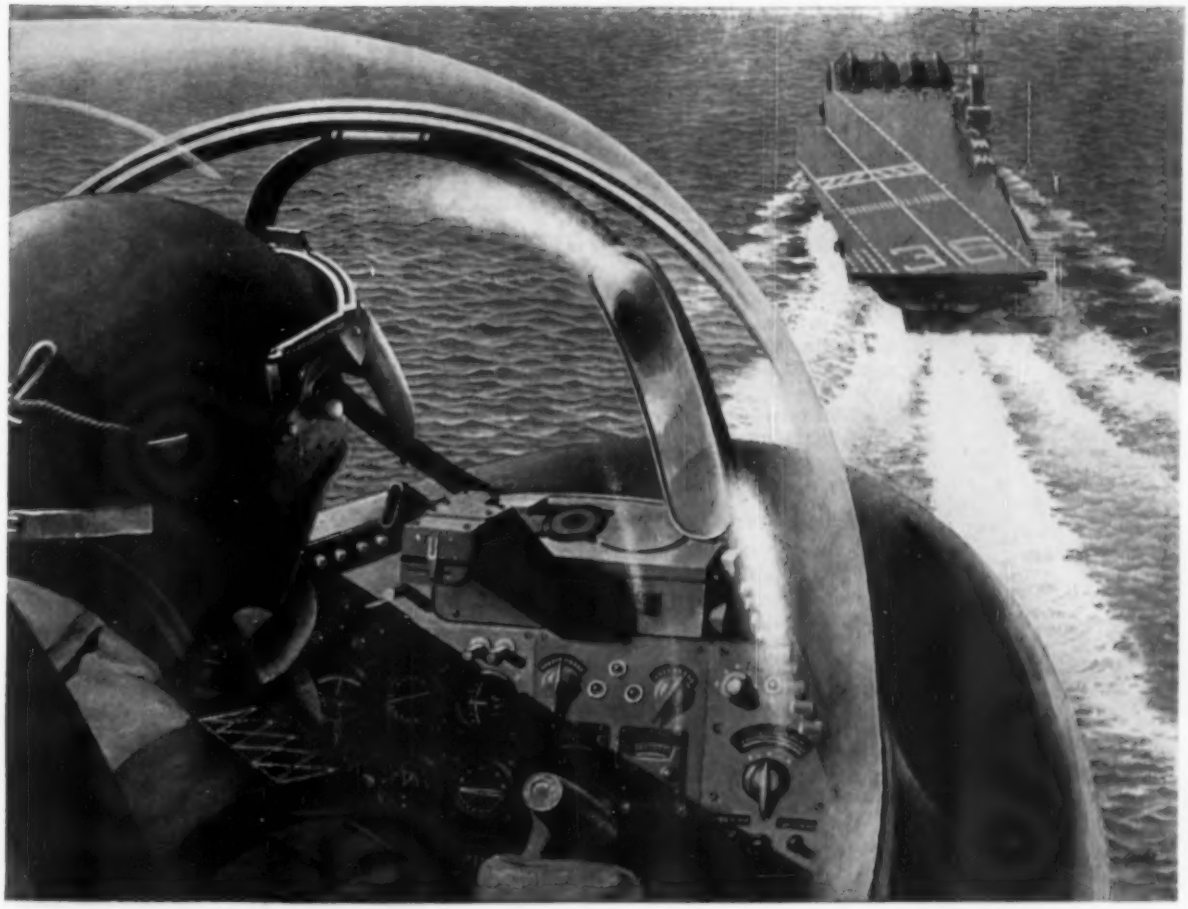

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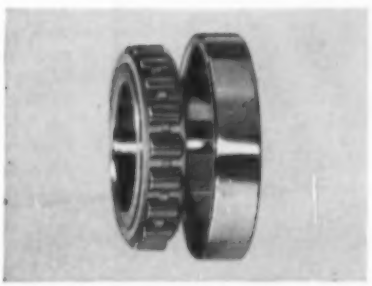

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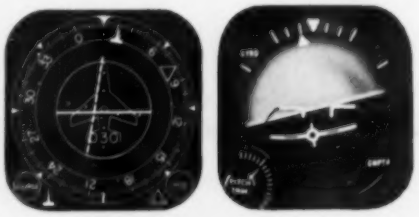
To show the wide range and flexibility of Bendix* Flight Director Systems, let's assume an ILS approach situation in which the airplane, on a 20° heading, is in a 10° right bank with its nose on the horizon, but slightly above the glide slope. The Course Deviation Indicator (same on all Bendix systems) pictures actual and pre-set headings, TO-FROM indications, and position relative to ILS beams (or VOR radial). Now, let's see how attitude reference and command information are presented on three typical Bendix Flight Director Indicators.

COURSE DEVIATION INDICATOR

FLIGHT DIRECTOR INDICATOR



BENDIX SERIES "300" SYSTEM

In this system the Flight Director Indicator presents computed roll and pitch commands. Sky and ground are represented on a sphere, as shown, and actual attitude is depicted by conventional airplane symbol. Secondary airplane symbol represents commanded attitude and, in this case, calls for nose-down, left bank maneuver. Command is satisfied when the two symbols coincide.

BENDIX SERIES "100" SYSTEM

This system's Flight Director Indicator also shows computed steering commands in both roll and pitch axes. Sky and earth presentation is flat rather than spherical, and white line represents horizon. In this version, the two pointed, opposing markers designate commanded attitude. Command is satisfied when wingtips of airplane symbol align with markers.

BENDIX SERIES "200" SYSTEM

The Flight Director Indicator in this system provides for computed steering commands in roll axis only. Flat gray and black areas represent sky and ground. Command bar is needle-like line extending up from bottom of indicator, and, in this example, calls for left turn. Commanded attitude is attained when this needle is straight up and down through center of indicator. Small horizontal bar's position with relation to vertical white dot scale along left edge shows whether airplane is above, below, or on glide slope beam.

With Bendix Flight Director Systems you have your choice of several types of presentation . . . and your choice of a single- or two-axis system. You *don't* buy features you don't want or need. Yet, you get all the features and advantages that you *do* want and need. When you think of flight directors, think of Bendix. Get the Bendix story.

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October 14, 1957

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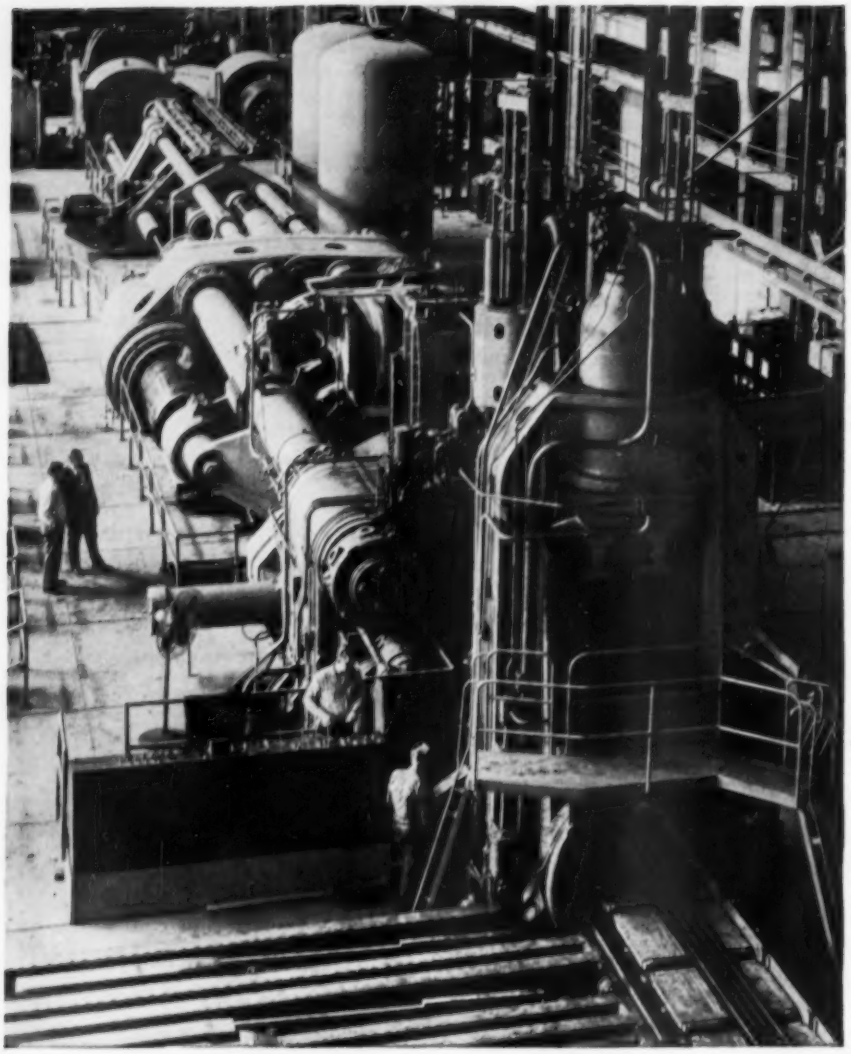
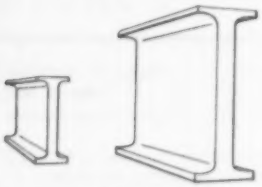


HOW THE 13,200-TON PRESS BOOSTS EXTRUSION CAPACITY



FROM 11″ TO 28″

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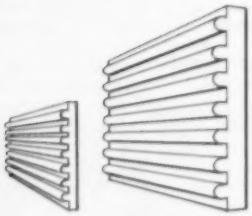

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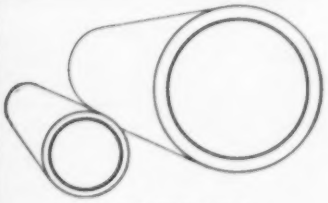

FROM 10″ TO 24″ O. D.

TUBING

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24-inch O. D. Tubing 28-inch I-Beams 80-foot-long sections

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If your design calls for large magnesium or aluminum extrusions, contact the nearest Dow Sales Office or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1406A-1.

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EDITORIAL

Sputnik in the Sky

The Soviet satellite (Russian name–Sputnik) now orbiting around the earth approximately 16 times every 24 hours at an average altitude of 400 miles offers incontrovertible proof of another major Russian scientific achievement. Already the Sputnik is beginning to transmit new knowledge of outer space back to earth. There is little question that the successful Soviet satellite launching is a major milestone in man's eventual conquest of space. All of the Russian scientists who participated in this venture deserve sincere and unreserved congratulations for their success.

Success of the Soviet Sputnik coming after a long chain of Russian surprises in the development of atomic-airpower weapons ranging all the way from jet bombers, supersonic fighters, both intermediate and intercontinental range ballistic missiles, and hydrogen warheads should be grounds for a major re-appraisal of the research, development and production programs of our own defense effort by top level political leaders.

Right to Know

We agree with Senators Styles Bridges and Leverett Saltonstall, distinguished Republican leaders, as well as with Senators Richard Russell and Stuart Symington, on the Democratic side, that such an investigation is absolutely vital to the future safety and prosperity of this nation and the rest of the free world. In fact, it is long overdue. We are glad to see signs that it will develop as a bi-partisan effort aimed at serving the best interests of this country rather than an ordinary partisan political skirmish.

We believe the people of this country have a right to know the facts about the relative position of the U.S. and the Soviet Union in this technological race which is perhaps the most significant single event of our times. They have the right to find out why a nation with our vastly superior scientific, economic and military potential is being at the very least equalled and perhaps being surpassed by a country that less than two decades ago couldn't even play in the same scientific ball park.

They also have a right to make the decisions as to whether they want their government to maintain our current leadership of the free world regardless of the cost in dollars and sweat or whether they wish to supinely abdicate this position in favor of enjoying a few more years of the hedonistic prosperity that now enfolds our country.

Major Issues

These are choices the citizens of this land must make for themselves. They are not decisions to be made arbitrarily by a clique of leaders in an ivory tower or on a golf course. To make these decisions properly, the people must have the plain and unvarnished facts.

There are three major issues that should be developed in the proposed Congressional investigation:

• **Dollars versus genuine military strength** as a yardstick of defense policy. During the past four years, there has been a growing fear by the Eisenhower Administration that "we can't afford" adequate defense. The military force goals promised by the administration have been so thoroughly under-financed that it has been obvious for several years that these goals would never actually be met. We need to know what a really adequate military structure would cost, how soon it could be developed and how effective it might be in meeting the threat not of today but of tomorrow.

• **Support of the defense effort** by the scientific community. There has been a steady deterioration of the relations between the Eisenhower Administration and the scientific community that are so vitally needed to fertilize and spark technological progress. The Robert Oppenheimer case; the policies of Atomic Energy Commission Chairman Lewis Strauss; the tragedy of Trevor Gardner in the Defense Department; the asinine security clearance procedures of government agencies; the contemptuous attitude of former Defense Secretary Charles E. Wilson toward science and basic research, and President Eisenhower's widely quoted dismissal of scientists as "just another pressure group" have widened a dangerous gap between this group and their government. We need to take positive action to fertilize the field of basic research, get the scientists fully integrated into the defense program and provide them with the modest but long term financial support they need to achieve progress as fast as possible.

• **Rising costs and delayed results** caused by vicious destructive type of inter-service rivalry in the Pentagon. In addition to the corrosive effect of this acid service strife, there is the strangling effect on policy decisions and action of the growing bureaucracy in the Office of the Secretary of Defense. There is little doubt that, regardless of political systems involved, the Soviets have organized their defense-science-industry effort on a more effective basis than the current situation that prevails in the Pentagon and the industry and science that now supports our defense effort.

Financial Bungling

Incredible financial bungling in the Pentagon described in recent issues of Aviation Week is sufficient to waste many precious months of useful, productive effort by both science and industry. Nor can there be much doubt that the defense structure that has grown by bureaucratic accretion during the past five years without any real leadership from either the White House or the Secretary of Defense is grossly inadequate to deal with the problems involving the future survival of this country. A major change is long overdue.

So lets have a thorough, bi-partisan investigation that will lay the facts on the line and provide the American people with an opportunity to devise their future fate. Maybe the Soviet Sputnik revolving in the sky will at last shake us out of the prosperous complacency and flaccid leadership that has gripped us for too many years.

—Robert Hotz

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WHO'S WHERE

In the Front Office

Henry S. Bears and **J. Doyle DeWitt**, directors, United Aircraft Corp., East Hartford, Conn.

Raymond H. Gardner, a director, Miniature Precision Bearings, Inc., Keene, N. H.

A. T. Burton, president, newly established Navan Products, Inc., wholly owned subsidiary of North American Aviation, Inc., Santa Monica, Calif. Also: **J. S. Smithson**, vice president. Burton and Smithson are officers of North American.

Donald M. Miller, executive vice president, Airborne Instruments Laboratory, Mineola, N. Y.

Dr. Ruben F. Mettler, Dr. Burton F. Miller and **Milton E. Mohr**, vice presidents, The Ramo-Wooldridge Corp., Los Angeles, Calif. Dr. Mettler is associate director-Guided Missile Research Division; Dr. Miller is director-Communications Division; Mr. Mohr is group director-Control Systems and Boston Divisions.

Walter G. Conrad, vice president and general manager, American Airlines de Mexico, S. A.

Honors and Elections

The Baltimore Association of Commerce will present the **Transcontinental Transport Trophy** to the **Boeing Airplane Company** to memorialize the Boeing 707 Stratoliner transcontinental transport speed record, from Seattle to Baltimore, on March 11, 1957. In the future the trophy will be offered to the manufacturer of the commercial aircraft holding the speed record for a flight from the Pacific Coast to Friendship Airport.

Arthur E. Raymond, vice president-engineering of Douglas Aircraft Company, has been selected to receive the 1957 Daniel Guggenheim Medal "for notable achievements in the advancement of aeronautics."

Changes

Herbert I. Chambers, chief development engineer, and **Francis T. Greenup**, chief product engineer, Consolidated Electrodynamics Corp., Pasadena, Calif.

Arthur E. Smith, assistant general manager, and **Perry W. Pratt**, engineering manager, Pratt & Whitney Aircraft, division United Aircraft Corp., East Hartford, Conn.

Robert R. Beachler, Jr., director of engineering, Leach Corp., Los Angeles, Calif.

Richard E. Krengel, general manager, Ex-Cell-O Corporation of Canada, Ltd., London, Ontario.

P. R. Perino, project engineer, Allegany Instrument Company, Inc., Cumberland, Md.

Samuel Bousky, director of engineering, Chicago Aerial Industries, Inc., Melrose Park, Ill.

Ralph Lehman, manager-aircraft instrument sales, Weston Electrical Instrument Corp., Newark, N. J.

Edward H. Muhleisen, manager-aircraft and missile industry, Fischer & Porter Co., Hatboro, Pa.

INDUSTRY OBSERVER

► Convair's Atlas intercontinental ballistic missile employs a cartridge that fires and exhausts into manifold to develop uniform pressure for separating liquid propellant rocket sustainer stage. Missile also uses gas turbine generator designed by American Machine & Foundry Co., which is driven by missile's liquid oxygen and fuel to supply electrical power.

► Douglas Thor intermediate range ballistic missile is formed of three skin sections, each spanning one-third of the missile's circumference. Skin has milled waffle pattern on its inside with webs about ½ in. thick.

► North American Aviation's Missile Development Division has formed a new space flight activity that will receive high priority support from management. In the overall picture, however, MDD's working force has been trimmed to fit within the Defense Department's economy move and to allow it to continue operating as a division.

► Douglas Genie air-to-air nuclear rockets are now being introduced to operational units of USAF's Air Defense Command.

► Lycoming's 1,005 eshp. T53 turboprop engine is expected to be qualified for production before the end of the year, with production beginning in 1958. One application is in Grumman's OF-1 high performance observation aircraft, which earlier this year won an Army/Navy competition for a STOL-type vehicle (AW May 21, p. 28).

► Production efficiencies and improved learning curve in fabrication have enabled Piper Aircraft to cut manhours on production of the Apache light aircraft by about 25% since the initial models were rolled out. Piper estimates that, without this saving, current basic Apaches would list for approximately $42,000. Present cost is $35,000. Maintenance of continuous high-level production runs also have been an important factor in maintaining the lower price. Originally, Piper thought it would take about five years to sell 1,000 Apaches, but it has sold more than that in three years.

► Pratt & Whitney T34 turboprop engines powering YC-97F in reliability study of engines and associated systems carried out 82 missions instead of 30 originally scheduled. During the tests, there were only five delays for maintenance. Of these, only one was associated with the powerplant. Pilots who have flown the aircraft report that on cold days they have achieved rates of climb of 6,000 fpm. immediately after takeoff at gross weights of 170,000 lb.; reached 12,000 ft. in two min., 16 sec.

► Doman Helicopters hopes to interest the military in a proposal to equip a Sikorsky S-56 with the Doman rotor head. Doman says conversion, which would cost an estimated $750,000 with the Army bearing the major share, would substantially reduce vibration.

► Czechoslovakia is now producing the MiG-19 Farmer, Russia's 900 mph. fighter. Earlier MiG-17 is being produced under Russian license in Czechoslovakia, Communist China and Poland.

► Allison is now producing approximately 35 T56 turboprop engines for the military each month; production capability is 100 per month. As of last month, Allison had produced a total of 1,150 T56s for the military, with the major portion of the output going into the Lockheed C-130 Hercules transport, of which 115 have been delivered. Allison also now has orders for approximately 780 civil versions of the engine, the 501D-13, from commercial operators for airliners and business aircraft.

► Douglas C-133 turboprop transport is scheduled to begin regular logistics support operations across the Atlantic by mid-April, 1958. C-133 unit, based at Dover, Del., now has three C-133s, expects to get its fourth in the near future. It will have 16 of the aircraft at full strength.

Ski-Jump with Jet Assist

A new version of the Fairchild C-123 is now flying with the USAF. Its wheel-ski combination gear enables it to operate from ice or snow-covered fields as effectively as from unprepared dirt strips.

Takeoff performance shoots up with the addition of a Fairchild J44 jet engine at each wing tip. Substantial increases in payload have become possible—takeoff and landing weights over 60,000 lbs. have been achieved and will become routine.

The ski-and-jet C-123 is typical of the versatile development and the potential Fairchild builds into its aircraft.

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Washington Roundup

Space Flight Regained

One accomplishment of the Russian satellite launching is the apparent discard of a USAF order labeling space flight a dirty word in Air Force parlance. Spate of stories on U.S. capabilities in the rocket field following the Soviet satellite launching was forced despite a July 29 directive which lamented news stories describing some USAF research and development as efforts in "space flight." The order reported bad reaction at headquarters, Department of Defense and congressional levels, and suggested avoidance of mention of space, space technology and space vehicles.

"No statements can be made," said the now-outmoded order, "which might in any way cause the national media to describe valid Air Force projects as efforts to fly to the moon."

Investigators

Sen. Estes Kefauver (D.-Tenn.) may become the dominant personality during the Senate Preparedness Subcommittee's investigation of the U.S.'s satellite and guided missile position. Kefauver is the second ranking Democrat. Sen. Lyndon Johnson (D.-Tex.), chairman of the subcommittee, is generally precluded from active participation in committee business because of his duties as majority leader. Other senators on the subcommittee are John Stennis (D.-Miss.), Stuart Symington (D.-Mo.), Styles Bridges (R.-N. H.), Leverett Saltonstall (R.-Mass.), and Ralph Flanders (R.-Vt.).

Partial Victory

Sharp disagreement still exists between the airlines and Civil Aeronautics Administration over which of two types of runway lighting systems is best suited for landing under low visibility conditions. Following a series of CAA tests at Andrews AFB near Washington (AW April 15, p. 99) with both narrow-gage and low-mounted fluorescent floodlight systems, the CAA strongly advocated the latter. Airlines, on the other hand, held that the narrow gage method was more adequate.

Industry concedes that the fluorescent units would be less costly to install on presently established runways but does not agree with CAA's contention that, under the narrow-gage system, the pattern of lights distorted when aircraft deviate from the runway centerline.

As a result, CAA will bow to industry's wishes and authorize installation of wide-beam semi-flush fixture in a narrow-gage pattern on the new runway at New York International Airport. However, the fluorescent floodlighting system will be installed at the Washington National Airport so that tests and studies of both systems can be continued.

McElroy: A Bow to Science

Neil H. McElroy, who took office last week as Secretary of Defense, gave an early bow to the world of science. "I am conditioned," said the former president of Procter & Gamble's soap empire, "to feel there must be support of speculative thinking by high-grade scientists. . . . I would not be on the side of any cutback." McElroy's remarks were interpreted as indicating a sharp contrast with the attitude of his predecessor, Charles E. Wilson. Wilson was inclined to scorn research projects, particularly of the speculative type that could boast of no immediate application to improved weapon systems.

'Snail's-Pace' Bilateral

Indications are that the U.S.-Brazil air transport agreement now under discussion will become one of the most carefully negotiated bilaterals in history because of recent charges of State Department "giveaways." Talks are progressing at a snail's pace with considerable time being spent in studying each phase. Discussion of route exchanges may still be a long way off.

Changing Times

National Missile Industry Conference, later called the National Rocket and Missile Industries Assn., has been christened again. Its new names—the Assn. of Missile & Rocket Industries or AMRI. Kendall K. Hoyt, acting secretary and spokesman for the group, says there is real need for the organization to provide a single point of contact between the services and the industry's "several parts" including "the makers of missile bodies."

Second meeting of AMRI will be held in Washington next week.

Rate Progress

International Air Transport Assn. traffic conference which opened here on Sept. 24 is expected to end late this week although agreement has not yet been reached on the controversial third-class fare issue.

Since strong contingent of airlines has strongly supported the preservation of a two-tier fare level, progress toward a settlement of the knotty problem of introducing a third level on North Atlantic routes has been slow. However, observers feel that, once differences on conditions under which the rates should be applied are ironed out, the conference will approve the proposed three-level fare structure.

Some airlines have been worried that the third-class rates will eventually spill over into the midatlantic routes and other areas to destroy the basic fare structure of IATA.

The conference is studying the possibility of overhauling the rate structure in order to strengthen and equalize revenue returns on international routes.

Existing rules governing charter operations have also been the center of much debate. Problem is due to a basic conflict in philosophy with one group of carriers supporting rigid charter regulations to protect the fare structure and another advocating more liberal rules to provide greater freedom in meeting non-IATA competition.

Protest by American

American Airlines, in a petition to the Civil Aeronautics Board, has protested the proposed use of sleeperette seats by Trans World Airlines on its transcontinental flights at regular first class fares. American's petition claims that the proposed service would be comparable to TWA's deluxe transatlantic service for which there is a $50 charge over and above first class fare. American wants CAB to either require TWA to file a tariff to cover the service or to take steps to prevent its institution.

—Washington staff

USAF Pushes Pied Piper Space Vehicle

Success of Soviet satellite will give new impetus to Lockheed project for reconnaissance satellite.

Washington—Soviet satellite launching will spur research and development efforts on advance U. S. space vehicles including Lockheed Aircraft Corp.'s Pied Piper project. Pied Piper, sponsored by USAF, is an earth-circling reconnaissance satellite. A later version would be manned.

Russia is working on at least one project similar to Lockheed's.

Popular nickname for Pied Piper is Big Brother. Weapon system number is WS-117-L. Lockheed calls the project ARS for Advanced Reconnaissance System.

Aeronutronic Systems Inc. also is conducting studies along lines similar to Pied Piper (AW July 22, p. 53), using its own and Air Force funds.

Rand Corp., supported chiefly by Air Force research funds, has pushed work on such satellites for the last 10 years. Other services also have plans for advanced satellites, including manned vehicles.

Pied Piper dates back to early 1956 when an airframe-avionics team headed by Lockheed won a competition against two or three other teams. Columbia Broadcasting System is probably Lockheed's teammate, with Eastman Kodak as an associate participant.

Original investment in Pied Piper was $4 million. This later was increased to $12 million for the first year.

Satellites for WS-117-L would carry television, photographic cameras, infrared spotter or radar scanner systems.

Systems Laboratories Inc. holds a one year contract, awarded about three months ago by Rome Air Development Center, for ground handling studies in connection with Pied Piper. Amount is approximately $140,000.

Its work is to determine requirements and accuracies needed for interpretation and processing of data relayed from the satellite and construction of large mosaics or maps.

The feeling is that Pied Piper could not be ready in the unmanned version before 1960 unless a tremendous effort is placed behind it. Manned version, even on an accelerated schedule, is closer to 1965.

Manned vehicle would remain in its orbit for perhaps a month. Biggest problem for a manned satellite probably is still recovery.

Launching vehicle for the reconnaissance satellite probably will be a three or four-stage liquid rocket system, with North American Aviation Inc. and Aerojet-General Corp. as the most likely engine manufacturers.

Approximately 500 to 1,000 lb. thrust will be required for one lb. of satellite weight.

Orbit for unmanned Pied Piper would be between 300 and 1,000 mi. Lower orbits, better for reconnaissance work, are worse from the standpoint of damage caused by denser air.

When satellites move from the area of collectors of geophysical research data to earth reconnaissance vehicles, legality will become a problem. Unless they are launched in a cooperative effort such as the International Geophysical Year, or with prior agreement among countries, relatively simple countermeasures probably could be used to bring them down.

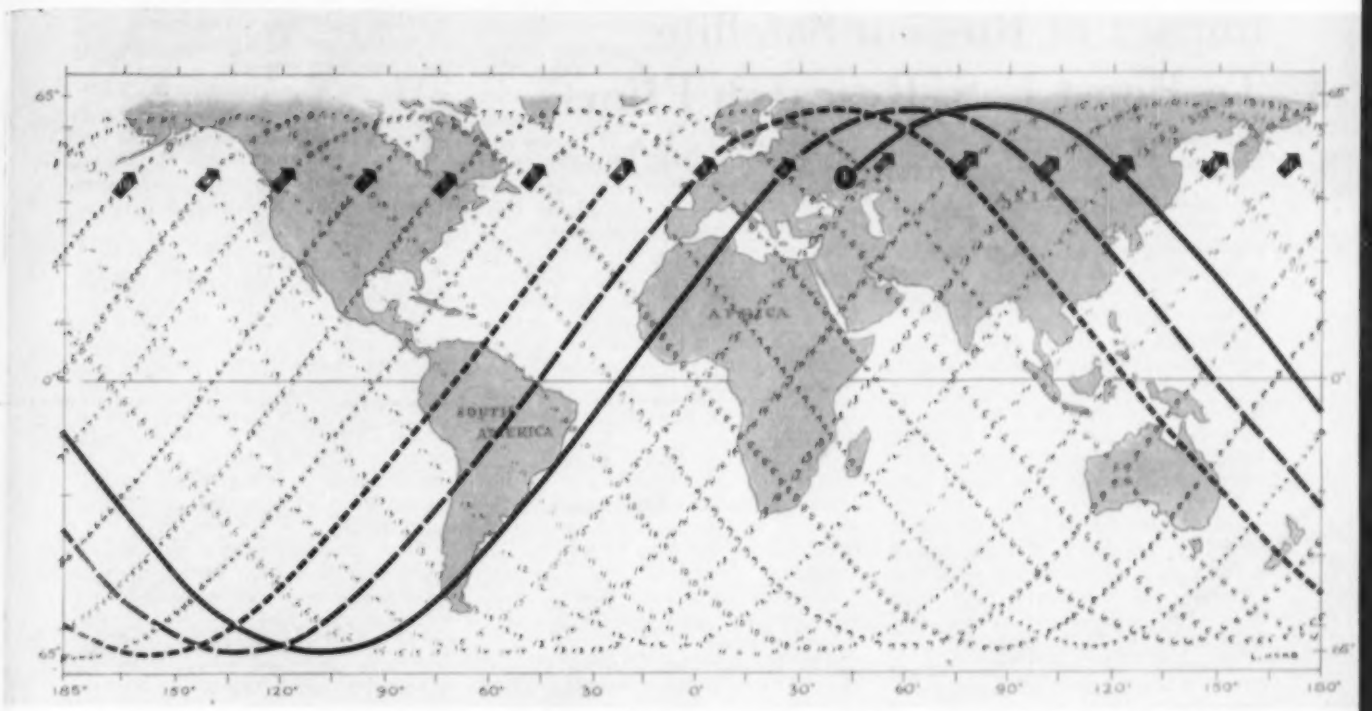
Other problems include:

- **Data transfer** from satellite to earth. "Picture" taken by satellite scanner must be changed from film or camera to electrical signals which modulate transmitter for relay to a ground station, where data would be put into continuous map form or recorded on film or magnetic tape.
- **Rotation of the satellite** on its own axis. It will have to be oriented to keep its camera, infrared spotter, radar antenna or whatever pointing in the right direction. This will require power and add to complications of equipment.
- **Jamming.** In addition to possibility that satellite could be shot down, equipment probably can be jammed or fooled comparatively easily.

Nevertheless, the ARS satellite is not considered a particularly difficult project, but more a question of adequate research and development funds and time. Problems of power to put the satellite into orbit and reliability of the equipment it will carry can be overcome with sufficient resources.

Russians Fly VTOL Vehicle

Soviet VTOL is hoped by Russians to be forerunner of passenger vehicle. Outriggers appear to be control jets. No rotor is visible indicating use of turbine powerplant.



APPROXIMATE path of Soviet satellite around the earth. As satellite circles earth, earth is rotating east. Satellite travels within bounds of 65 deg. north lat. and 65 deg. south lat. Arrows indicate direction of orbit.

Russian Satellite Transmits Some Data

Washington—First Russian satellite, weighing eight times as much as U.S. satellites will and launched into a more difficult orbit, contained at least crude instrumentation in addition to its radio transmitter.

Normal 0.3 sec. duration of the radio signal was increased or decreased to indicate temperature changes of 50C or more.

Sphere weighed 184.3 lb., measured 23 in. in diameter, had four antennae and was made of aluminum alloys. It was filled with nitrogen which, according to the Soviet newspaper Pravda, was "forcibly circulated during the flight."

Satellite Instrumentation

Earliest Russian statements said the satellite contained no instrumentation—only a transmitter and batteries. Officials familiar with U.S. satellite instrumentation work said the weight figure could easily have been that high if non-miniaturized batteries were used. But most of them doubted from the beginning initial statements that the satellite contained only radio and batteries and that signals were not coded.

Later Russian official statements spoke of "all the instruments" and said the satellite "has light sensitive elements which alter the radio frequencies of the signals and the correlation between their durations and intermissions as soon as the temperatures or other parameters of the satellite change."

Radio Moscow said the satellite allowed observation of changes in "absolute intensity of the energy of the electro-magnetic pole."

Protective nose cone and final third stage of "an excellently designed carrier rocket" also orbited, the Russians said. This would give a basis for comparison of speeds of orbit of each, from which drag might be calculated.

Pravda said "an extremely accurate and effective system of automatic controls was designed for the rocket to ensure the earlier determined trajectory necessary to take satellite to its orbit."

In language similar to the recent Russian announcement of a successful intercontinental ballistic missile firing, statements on the satellite launch said achievement of the goal "has fully confirmed the correctness of the calculations and basic technical solutions made in designing the carrier rocket and satellite."

Russians had given early advance notice of its firing plans (AW June 17, p. 25). Last June 1, Pravda reported an interview with the president of the Soviet Academy of Sciences, hinting that a "great breakthrough" in the satellite race was imminent.

Launch was made at 5:05 p.m. EDT on Oct. 4 at an angle of 65 degrees north of the equator. Russians said they came within one mile of attempted orbital altitude of 559 mi. Highest altitude reached in slightly eliptical orbit was about 600 mi., Pravda said. Time for one revolution averaged about 96.1 min.

Launching Site

Launching site probably was north of the Caspian Sea at the site frequently used for intermediate range ballistic missile firings.

U.S. experts estimated weight of a rocket necessary to carry a 184.3 lb. satellite to 559 mi. at between 200,000 and 300,000 lb. They considered this the most significant factor in the Russian achievement and speculated that a modified ICBM booster formed the first stage of the launch vehicle.

Pravda reported that later instrumented satellites would be fired and said "the Soviet Union will also launch a satellite having animals as passengers for the purpose of studying the behavior of living organisms during cosmic flight."

A Radio Moscow home service broadcast said manned satellites would follow, and beyond that would come exploration of the planets.

Impact of Russian Satellite To Boost U.S. Research Effort

By Evert Clark

Washington—Impact of Soviet satellite success, latest in a series of impressive Russian technological achievements, already has raised the status of military research and development from its lowest point in years.

Although the U. S. satellite timetable apparently will not be accelerated, observers here agree that the Russian launching will serve as a stimulus to research and development programs that will help considerably to overcome the adverse affects of budget cuts.

Defense Secretary Neil McElroy, who took office five days after the Soviet satellite was placed in its orbit, said at his first press conference last week that "Russian missile programs have made it seem not unimportant to us to end bottlenecks" in U. S. programs.

Although "we aren't thinking in terms" of much greater defense expenditures, McElroy said, there probably will be an increase in testing, more overtime work at missile centers and more rapid evaluation of missile data.

Budget Size

The new Defense Secretary said he did not know whether $38 billion dollars a year is enough for a defense budget but that he intends to find out because "the people have a right to an answer."

"ICBM talk in Russia" and the estimated power of the satellite launching rockets "reveal something about the status of the Russian missile program," McElroy said. He called Russian technological advances "substantial" and said it is "not inappropriate for us to take whatever we think are the proper programs for us vis-a-vis the Russians."

He said an acceleration in missile testing efforts is under consideration but not "urgent consideration."

The general tone of his statements was in contrast to reaction a few weeks ago by former Defense Secretary Charles E. Wilson, Secretary of State John Foster Dulles and the White House when Russia announced a successful firing of an intercontinental ballistic missile.

President Eisenhower, at a press conference earlier on the same day McElroy spoke, said "I have had every group (of defense officials and scientists) that I know anything about, to ask them is there anything more we can do in the development of our rocket program any better than is being done? And, except for certain minor items or, you might say, almost involving administration, there has been little said."

The President said that, if the Russian satellite weighs "180 pounds," it "has astonished our scientists." He also said he saw nothing significant in the Russian satellite launching at the moment "as far as security is concerned, except, as I pointed out, it does definitely prove the possession by the Russian scientists of a very powerful thrust in their rocketry, and that is important."

The Soviet satellite "in itself . . . imposes no additional threat to the United States," the President said. He also said he "wouldn't believe that at this moment you have to fear the intelligence aspects of this" satellite. "Apparently, from what they say, they have put one small ball in the air," Eisenhower said.

The President said Defense Department's "missile czar," William Holaday, "couldn't receive new instructions from me" as a result of the satellite launching "for the simple reason that if he doesn't know more about it than I do, I am very foolish to have him there.

"Now, I have provided to the limit of my ability the money that they asked for, and that is all I can do."

Last estimate he had on military research and development spending, "the money we spend yearly without putting a single weapon in our arsenal, is $5.2 billion," the President said. "Now that isn't any weak, pusillanimous effort; that is a lot of money."

President Not 'Hysterical'

Asked if he had had any advance information that a Russian satellite launching was imminent, President Eisenhower said:

"Not imminent. For a number of months different scientists have told me, or different people—I don't know whether it was ever told to me officially—that they were working on it, they were doing something about it, but—but again no one ever suggested to me as anything of a race except, of course, more than once we would say, well, there is going to be a great psychological advantage in world politics to putting the thing up, but that didn't seem to be a reason, in view of the real scientific character of our development, there didn't seem to be a reason for just trying to grow hysterical about it."

In spite of the President's apparent attitude that no changes are needed, officials of the three services who deal directly with research and development privately expressed strong beliefs that all research and development work will get a searching new review.

They also believe the pressures building up from the scientific and academic communities, to some degree in industry and to a great degree on Capitol Hill, are bound to result in greater economic and administrative freedom for research programs.

Basic research, particularly, has been given a boost by the Russian satellite launching, observers here feel.

One potential danger that some research men see is that the pendulum might be swung too far the other way—that overzealous congressmen may attempt to impose an impractical Manhattan District type of administrative structure over the missile program or smother research efforts under an avalanche of funds and expectations of quick results.

Most, however, believe that Russia finally has done what no one in this country had been able to do—sold the importance of basic research to the public and to some government officials who have continued to underplay its importance since before World War II.

Effect on Vanguard

Project Vanguard, the U. S. satellite program administered by the office of Naval Research and the National Science Foundation in connection with the International Geophysical year, apparently will not be directly affected by any shift in official attitudes.

Some scientists objected two years ago when first announcement of a U. S. satellite program was made by the White House, on the grounds that it put what was basically a scientific effort into the political and propaganda arena.

Now there is considerable criticism—some of it from the same scientists—that the U. S. failed completely to recognize and capitalize on the potential propaganda advantage of being the first to launch an earth-circling satellite.

Army missile experts also have been openly critical of the fact that no advantage was taken of available Army rockets to launch a crude satellite in order to win the "race" with Russia.

Vanguard was chosen for the U. S. satellite program over the Office of Naval Research-Army Project Orbiter on the basis of a compromise between a low-cost project done with minimum cost and a sophisticated enough project to obtain significantly valuable scientific data.

Based on the Martin Viking rocket, which in turn was based on the German V-2, the three-stage launching vehicle for Vanguard still had not been fully tested when the Russian satellite was launched.

Usual development problems with

the General Electric Co. first-stage engine, Aerojet-General Corp., second-stage engine and the Martin Co.'s launching vehicle (AW Aug. 26, p. 29) did not slow the program down—it simply increased the cost. Timetable and performance specifications remained unchanged.

Total cost now is expected to be $110 million. Capt. A. B. Metsger, deputy chief of naval research, said earlier this year that, if Vanguard is successful in its time limit and for the $110 million, "This will be the quickest and cheapest rocket project that has ever been seen, and I think we may well do it. This is a bargain-basement job."

Vanguard officials feel the project is far enough along now that it would be difficult to accelerate it even if that were desirable from the political-propaganda point of view.

Next step after firing of the TV-2 to test the first-stage engine in flight (AW Aug. 26, p. 86) is firing of four complete Vanguard vehicles with 4 lb., 6.4 in. magnesium spheres. Although Navy has de-emphasized the possibility that smaller satellites might end up in an orbit, it is understood they are as likely to orbit as larger 20 in. instrumented satellites if the launching vehicle performs properly.

Timetable calls for firing of larger spheres next spring. Less difficult eastern direction for a launch was chosen to take advantage of earth's rotation. Vanguard technical director Milton Rosen says the Vanguard approach "has been to maintain a substantial excess velocity capability and to hold the precision of the guidance to that acceptable for a minimum performance vehicle (AW July 29, p. 31)."

Vanguard satellite will be launched from Cape Canaveral, Fla., at a declination of 35 degrees from the equator. This is a compromise between the angle that would give maximum rotational acceleration and a desire to permit observation in the temperate zone.

USSR Propaganda Advantage

Russia gained maximum propaganda advantage from her launching by:

- **Choosing 20 and 40 megacycle** transmitter frequencies instead of the 108 mc. chosen by the U.S. This enabled ham radio operators around the world to catch the signals, which many could not at 108, and required quick fixing of U.S. radio tracking equipment. Russia announced her intention to use these frequencies to her own operators in the June issue of Radio magazine.
- **Choosing an orbit** that, although more difficult to hit, brought her satellite over virtually every inhabited area of the earth.
- **Timing the launching to coincide** with the international meeting of International Geophysical Year Rocket and Satellite scientists here and the International Astronautics Federation meeting in Barcelona, Spain. Some scientific observers here doubt that this was Russia's first launch attempt. They say they doubt that capability or luck or a combination could pay off so completely.

They theorize that previous tests had been made with political timing of the firings an important factor.

One high-ranking naval officer, who is familiar with both research and development efforts and procurement in his service, reacted to the Soviet launching this way: "If their satellite weighs 18.4 lb. they are ahead of us. If it weighs 184 lb., I'm scared!"

Satellite's Glow Permeates Barcelona

By David Anderton

Barcelona—Russia's satellite has totally eclipsed this Eighth International Astronautical Congress. Tremendous technical accomplishment of the Soviet scientists in launching a large and heavy satellite into the difficult north-south orbit came as a shock to many delegates here. Even the objective view that the Red Star was less sophisticated than the proposed Vanguard satellites could not take the glow off the formidable task the Russians completed.

Coming on the heels of the Russian announcement of initial successes with the ICBM, news of the satellite launching took on even more importance. This is the second recent major scientific milestone. Observers felt that the Russians have passed ahead of the western world.

Send Congratulations

There was general agreement among delegates that the Russian advantage of being first could not be downgraded by anything done later, even though better. In spite of this there was much animated informal discussion about what the U.S. could do to recoup some of its scientific prestige. Manned space flight or hitting the moon were the two most common suggestions, but even these were tinged with doubt that there still existed an American lead in these categories.

"What can we do now?" said one official of the International Astronautical Federation. "We sent them a congratulatory telegram."

It was sent to Moscow late Monday afternoon.

One European bitterly contrasted the 23 U.S. papers at the Congress with the five Russian presentations. "The Americans talk about it and the Russians do it."

Russian Academican Leonidas Sedov, heading the two-man, two-woman Soviet delegation, drove the point further home by offering instrument space in one of the next Red satellites to an American scientist, who hours later was still seriously pondering the proposal but was afraid to accept because he felt it would hurt him professionally.

No discrepancies have yet been found in data issued by a Moscow radio communique. Flight path velocity of 26,200 fps. is consistent with the orbital altitude quoted of 560 mi., and time for one complete revolution of 1 hr. 35 min.

Satellite diameter of 1.9 ft. and weight of about 184 lb. give average density for the sphere—if it is a sphere—of about 52 lb. per cubic foot. This number is consistent with estimated unit weights frequently used in preliminary design work for avionic equipment.

There is belief that the satellite contains two transmitters, one for sending a position signal or identification note that has been picked up in locations all over the world, and the other for sending coded transmissions of data.

Satellite Signals

Signal strength of identification note is great enough to be picked up by amateurs without special equipment. Russians also pointed out that the Red Star could be seen at sunrise and sunset with simple visual aids and released the ephemeris (timetable) for the satellite giving times of arrival over the world's major cities. Russian secrecy maintained on the satellite program extended to four scientists at the Congress.

Sedov seemed to be as surprised as anyone in the knowledge that the first attempt had been successful. Other members of the Soviet delegation had no information on the satellite and claimed to be ignorant of such major factors as the launching site because "at least four were available." Russians here are isolated from direct contact with Moscow because there are no diplomatic relations between Spain and Russia. Suggestions that the Russians call back for more information were met with polite refusal on these grounds, and further suggestions that they could relay messages through a number of countries were also turned down with the comment that technical information didn't relay well.

Soviet satellite secrecy also hints at

Turbine-Powered Vertol Starts Flight Tests

Vertol H-21D Shawnee helicopter, fitted with two 1,024 ehp. General Electric T58 gas turbines takes off from Philadelphia International Airport, Pa., on start of extensive flight test program under a BuAer contract for the U. S. Army. Contract totals $1.8 million, also involves ground testing of a second turbine-powered Shawnee. T-58-powered Shawnee is expected to show payload increase of 40%, speed increase of 50% and several thousand feet ceiling increase over standard H-21s powered by a single piston engine.

more than a slight connection between it and that country's ICBM work. It is almost certain that a Russian ICBM booster was used for the satellite. Inclination of orbit at 65 deg. to the equator might have been determined by the layout of long range missile test grounds in Russia.

Transmission Frequency

Transmission frequencies used—about 24mc.—are rated as poor for satellite use but excellent for Doppler radar work and probably came from existing Doppler or DOVAP equipment developed for tracking Red ICBMs and adapted for satellite use.

Those who did believe the Russians had the capability to fire a successful satellite expected the firing sooner. Birthday of Tsiolkovski, 19th Century Pole, since adopted by the Russians as their own, and father of space flight, was in mid-September and was widely expected to be the time for the first satellite attempt but missilemen pointed out that a two- or three-week delay in firing is almost normal and that the satellite launched Oct. 4 may well have been the first one. One engineer has speculated that their first successful ICBM firing announced a few weeks back was actually an unsuccessful satellite attempt.

Meantime the Congress, concerned about some of the possible legal implications of the satellite and early approaches to space flight, has appointed a seven-man committee at the suggestion of Andrew Haley, Washington corporate lawyer and former president of Aerojet and the American Rocket Society. Chairman of the committee is Prof. John Cobb Cooper, general council to IATA, who was nominated by Haley. Also named to the committee was Dr. Athelstan Spilhaus, U. S. delegate to UNESCO and a widely respected scientist. Sedov has agreed to submit a proposal to the Russian Academy of Sciences, who will name two representatives to the committee.

To Define Airspace

Outgoing IAF president, Dr. Leslie Shepherd of the British Interplanetary Society, will appoint the remaining three members. Intended makeup of the committee is four physicists and three lawyers.

Its job is to draft a definition of airspace and recommend a rule delineating airspace jurisdiction.

Resolution will be transmitted to the Secretary General of the United Nations and the Secretary General of the International Civil Aviation Organization with proferred cooperation. American Rocket Society and American Astronautical Society are two U. S. members of IAF.

But the major purpose of the Congress was an exchange of technical information leading to space flight. During the week of technical sessions and committee meetings, delegates heard these reports from the 45 papers presented:

• **Satellorb system,** an observation and research balloon simulating satellite conditions, was proposed by Maj. David Simons of the Space Biology Branch, Aeromedical Field Laboratory, Holloman AFB, New Mexico. Simons, who recently sat in a balloon for 32 hr. at an altitude of 19 mi., says Satellorb provides an observation platform for long-duration upper air observations that can't be duplicated in rocket powered aircraft or with rocket vehicles. Most exciting possibilities are in observations of the planets.

• **Electromagnetic** acceleration of highly ionized gases appears to be one possible successor to the chemically fueled rocket, according to Col. William Davis of the Air Force Office of Scientific Research. Air Force support of basic studies in plasma jets and Magneto-hydrodynamics is aimed at understanding complex phenomena and proving theory. One imagineered concept of a propulsion system would use an airburning ramjet to get from lower

atmosphere to ionosphere and shift to an electromagnetic accelerator ramjet for high altitudes.

• **Interplanetary** ballistic missiles were proposed as astrophysical research tools by Dr. S. F. Singer, University of Maryland. Singer suggests the use of an IRBM to blow craters on the moon with an H-bomb warhead. Such firings are completely feasible and about equal in difficulty to firing an ICBM with the same warhead. Singer says explosion of an H-bomb in a vacuum on the moon would give a more accurate calculation of energy output and bomb efficiency. Obvious genetic hazards and fallout damage present in H-bomb tests on earth are eliminated. Scientific benefits would include checking the prediction of the theory of meteor craters; meteor observations based on ejected dust and rubble captured by earth gravitational field; studying the effects of dust on earth, weather and climate. One engineer wanted to know what would happen if the people on the moon retaliated.

• **Highspeed aircraft** for retrieving manned earth satellites were proposed by Norman Petersen, research engineer of Sperry Gyroscope Co. Scheme is based on use of aircraft with only a slight performance improvement over X-15. Capture velocity was established at 7,000 fps. at about 200 mi. altitude. A three minute transfer time for payload seems to be realizable, Petersen says.

• **Russia** has 67 stations for visual observation of satellites, according to Alla Masevich, Russian astrophysicist. She pointed out that the Soviet scheme is very similar to that proposed for the U.S. and said that their stations were willing to participate in tracking the American satellite.

• **A sphere** about three feet in diameter, weighing about 400 lb. and partially covered with Teflon to protect the vehicle against high heat inputs, was proposed by Carl Gazley and David Masson of Rand Corp. as a means of recovery of a circumlunar instrument carrier. One design condition is 300G deceleration at 80,000 ft. for vertical re-entry. Vehicle is designed for water impact, and foaming plastic fills void space in the instrument package for flotation. Avionic gear would be potted (encapsulated) and connected to the body of the vehicle by plastics chosen to be compatible with deceleration loads tolerated by internal components. Equipment package would be a relatively small portion of the overall volume

Senate Group Probes Satellite Progress

By Katherine Johnsen

Washington—Congress responded to the launching of a Russian satellite by promptly beginning an investigation into the relative status of U.S. program last week by the Preparedness Subcommittee, a subcommittee of the Senate Armed Services Committee headed by Sen. Lyndon Johnson (D.-Tex.), Senate Majority Leader.

An investigation was first urged by Sen. Stuart Symington (D.-Mo.), former USAF Secretary and chairman last year of the Armed Services Subcommittee on the Air Force (AW Feb. 4, p. 32). The move was firmly supported by Sen. Styles Bridges (R.-N.H.) and Sen. Leverett Saltonstall (R.-Mass.), the two top-ranking Republican members of both the Armed Services Committee and the Appropriations Committee.

After a consultation with Johnson, Sen. Richard Russell (D.-Ga.), chairman of the full Armed Services Committee, reported that the staff of the Preparedness Subcommittee has been instructed to "assemble all available facts for evaluation." After this is completed, Russell said, "we will then be better able to determine the wisest course to pursue."

Directors of the staff are:

• **Don McGillicuddy,** who has been with the subcommittee since 1951, and before that was an agent of the Federal Bureau of Investigation.

• **Solis Horwitz,** who joined the staff a few weeks ago. Horwitz previously served as general counsel of the Reconstruction Finance Corp. and was with the staff of the House Armed Services Committee during its 1949 investigation of the B-36 bomber program.

Symington is skeptical of having the investigation localized with the subcommittee. He suggested to Russell that "this issue is of such grave importance that it warrants the prompt attention and judgment of all the members of the full committee. . . . It involves national survival."

Despite the White House's expression of complacency, Republican as well as Democratic leaders in Congress generally reacted to Russia's satellite accomplishment with concern.

The President's position, as stated by White House Secretary James Hagerty: "We never thought of our program as one which was in a race with the Soviet's." Declaring that the Soviet accomplishment would have no effect on the U.S. program, he added: "Ours is geared to the International Geophysical Year and is proceeding satisfactorily in accordance with its scientific objectives."

Congressmen are looking to the outcome of the staff investigation of the Senate Preparedness Subcommittee to point the way. But, regardless of their findings, it appears obvious that Congress is determined to crack down on inter-service rivalry, particularly in the missile field, and perhaps more for changes in the organization of the Defense Department. Generally, among both Republican and Democratic leaders, the sentiment appears to be that what is needed is not additional funds for the defense effort, but re-channeling of funds and cooperative effort.

Rep. George Mahon (D.-Tex.), chairman of the House Appropriations Subcommittee on Armed Services, commented:

"The sad fact is that today the armed services appear to be more interested in out-doing each other than in getting ahead of the Soviet Union. . . . First, the Army came to us and said they could do the (satellite) job best. Then the Navy came. We left the administrative decision to Defense Department. But it appears there was little spirit of cooperation. . . . There appear to be far more compelling reasons now for a merger of the Air Force and the Army than there ever were for separating them. . . ."

Following are individual comments on Russia's satellite accomplishment indicating the trend of thinking of top Congressional leaders:

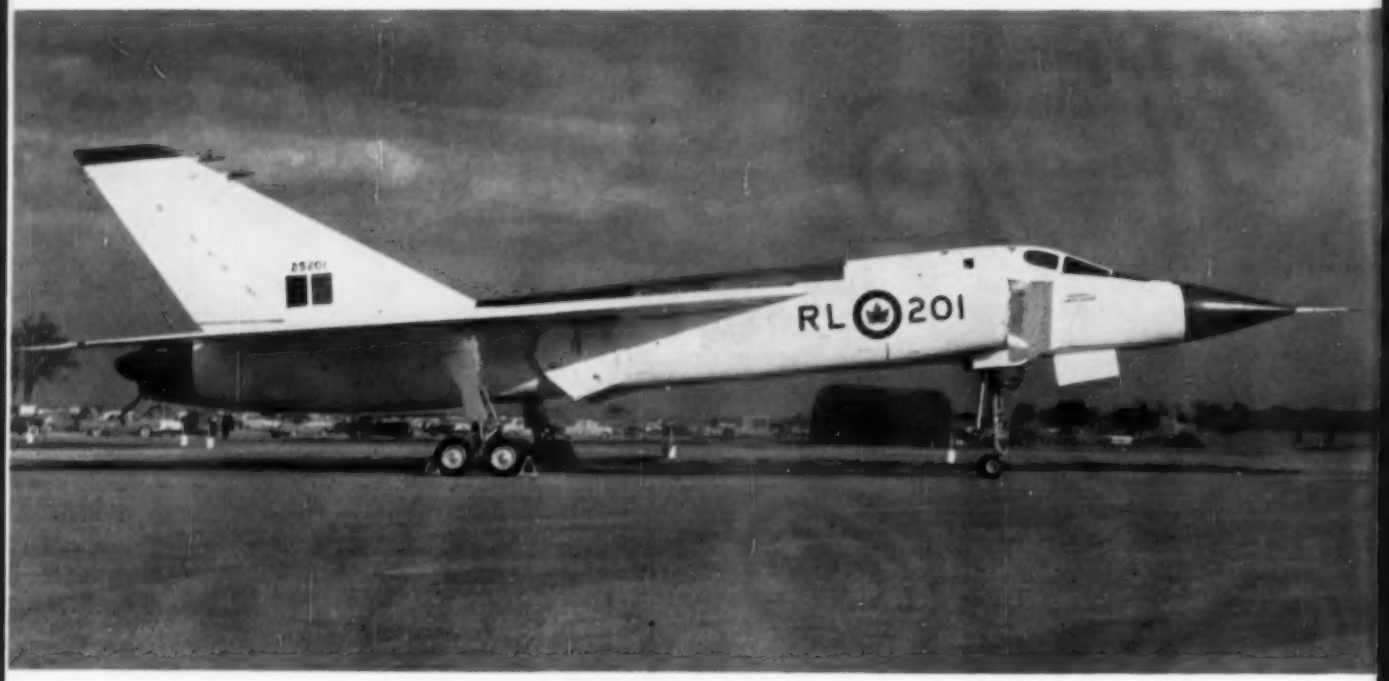
• **Sen. Richard Russell** (D.-Ga.), chairman of the Senate Armed Services Committee.

"We now know beyond a doubt that the Russians have the ultimate weapon —a long-range missile capable of delivering atomic and hydrogen explosives across continents and oceans. . . . However, this is no time for panic or fright. . . . We must give first place to our own

Testbed Crash

Los Angeles—Lockheed's Super Constellation testbed equipped with Allison 501 turboprop engines to be used on its Electra transport crash landed last week at Edwards AFB, Calif., with Lockheed test pilot Herman Salmon at the controls. Salmon was uninjured.

The left landing gear of the Constellation failed to extend because of a hydraulic failure not associated with the engines. One propeller was bent and one wing tip damaged in the landing. There was no immediate indication as to how long the test program will be delayed.



CF-105 Rolls Out

First Avro CF-105 Arrow, twin-engine, two-place, long-range interceptor is rolled out at Toronto. Aircraft has a take-off weight of about 60,000 lb. and its production models will be powered by Orenda Iroquois engines delivering approximately 60,000 lb. of thrust with afterburning. Flight testing is to begin before the end of December. First few flight test aircraft will use J75 engines as a safety measure so an untried aircraft will not be tested with a new engine. The Arrow is area ruled, has a very thin wing with conical cambered leading edges and blunt trailing edges, and is equipped with fixed geometry engine air inlets. High drag due to air spillage around the inlets is prevented by taking spillage air into the fuselage through a large number of perforations on the ramp just ahead of the inlet. The air is ducted aft and dumped. Complete details of the Arrow will appear in the Oct. 21 issue of Aviation Week.

missile program and appeal to our best brains and talent. . . ." Russell also deplored "a very foolish" cutback by the Defense Department in the atomic-powered aircraft program.

• **Sen. Styles Bridges** (R.-N. H.), ranking Republican on both the Armed Services and Appropriations Committees and former chairman of the Appropriations Committee.

"A prompt and thorough inquiry into the satellite situation, and its relationship to the whole missile program, is imperative. While it cannot be said at this point exactly what should be done, it appears obvious that there should be a greater concentration in the missile field—this might involve additional money from Congress, it might mean the transfer of funds from other projects, it might mean a reorganization of the military research organization. . . ."

• **Sen. Leverett Saltonstall** (R.-Mass.), former chairman of the Senate Armed Services Committee.

"Confidence in the U.S. program must be sustained. I am hopeful that during the Geophysical year we shall come forward with our own advancements in ballistic missiles and satellite research. . . . It appears that an excessive competitive spirit among the services is a drawback in our missile program, and this is a factor our subcommittee staff must evaluate. . . ."

• **Rep. John Taber** (R.-N. Y.), ranking Republican and former chairman of the House Appropriations Committee.

"The Russians are evidently ahead of us, and we must use every means at our command to see to it that we catch up. I do not think that this necessarily means new funds from Congress for the Defense Department—they already have billions down there unallocated. . . . I do think there may be a need for a reorganization in the research effort. . ."

• **Rep. George Mahon** (D.-Tex.), chairman of the Appropriations Subcommittee on the Armed Services.

"The Russians have demonstrated explicitly that they are ahead of us in certain fields. . . . I personally believe that they are ahead of us in the whole rocket and ballistic missile field. . . . I feel that this situation is in the most part a byproduct of unwholesome inter-service rivalries. . . . There simply must be a major defense reorganization approaching a merger. . . ."

Litton-Aircraft Radio May Merge

Agreement in which Litton Industries of Los Angeles will acquire control of Aircraft Radio Corp., Boonton, N. J., is being submitted to the stockholders of both companies. If approved Aircraft Radio will operate as a subsidiary of Litton.

Page Airways Buys 95 B-36s for Scrap

Page Airways, Inc., Rochester, N. Y., purchased 95 Convair B-36s of 200 that are being scrapped by Air Force and will melt the stripped carcasses down into aluminum ingots for resale. Engines and instruments still on the carcasses will be salvaged for sale. Page bought the 95 surplus B-36s for $831,345. USAF had stripped some $46.8 million worth of piston engines, parts, radio, electronics gear and flight instruments from the 95 airplanes sold Page to support remaining B-36s.

Scrapping of the 200 intercontinental bombers, long a mainstay of Strategic Air Command, is expected to produce a salvage value of about $93.5 million.

Additional Cutbacks Planned by USAF

By Claude Witze

Washington—Further cutbacks of not less than 14% will be imposed on USAF's Fiscal 1958 aircraft procurement schedule about the first of November.

Pace of the revised program, if unchanged, will result in a 92-wing Air Force in less than three years. Present USAF wing strength is 132, with a drop to 123 planned by next June 30.

Additional stretchouts also are expected for Navy contractors. Bureau of Aeronautics expects to start work on new schedules for its major weapon system suppliers not later than next week.

The $38 billion expenditure ceiling imposed on the Defense Department by the Eisenhower Administration is the direct cause of the new reduction in force goal.

In the case of the Air Force, the new stretchout in deliveries will be the final resolution of what appeared a week ago to be an effort to press contractors into a financing operation. Initial approach was to assign expenditure limitations to each major contractor (AW Oct. 7, p. 30).

Contract Ceilings

Authoritative sources last week indicated that the ceilings will be imposed, contract by contract, on all contractors with an uninvoiced dollar balance of $5 million or more. It appeared clear, however, that USAF will keep contractors within these ceilings by delaying deliveries and slowing down production lines.

Loans by banks to contractors will be required only when expensive items already in process are ready for delivery in the next few months and there is no cash in that contract's allotment to pay for the finished weapon system. This still is a major financial problem for many manufacturers, but the burden will be reduced in direct proportion to the speed with which they make readjustments to the new production schedule.

Contractor forecasts of estimated billings were due at Air Materiel Command headquarters last Thursday. AMC expects it will take from two to three weeks to evaluate the figures. Contractors then will be called upon to readjust schedules where necessary to keep within the ceilings.

Major question will be centered on how the economy bite will be spread. It is possible that the immunity previously enjoyed by ballistic missile projects will be ended, and that some

USAF Cutback Rundown

Washington—Here is a rundown of directives received by the aircraft industry over the last six months as USAF moved to cut expenditures to fit within spending ceilings ordered by the Eisenhower Administration. Missiles are exempt from these directives:

- **May 16—All services restrict overtime payments. Payments above 2% of the total manhours on a project must be approved by the respective services.**
- **May 16—Maj. Gen. David Baker, now retired but then Air Materiel Command director of procurement and production, reports that the aircraft industry has 26 million sq. ft. of excess floor space which constitutes an overhead that will not be an allowable cost.**
- **May 21—Directive prohibits partial funding from appropriated funds unless exceptions are made by the Secretary of Defense.**
- **May 22—Appropriated funds totaling $500 million are blocked from obligation until the beginning of Fiscal 1958. This money actually began to become available in September.**
- **May 31—USAF Secretary James H. Douglas protests "drastic effects" of May 21 directive in letter to Defense Secretary Charles E. Wilson.**
- **June 19—Directive orders that contracts must be performed without overtime except when authorized by the Secretary of Defense.**
- **June 20—Air Force Secretary Douglas and staff briefs aircraft and missile contractors, outlining program for reducing development and production costs.**
- **July 1—Air Materiel Command tells contractors to supply forecast of billings for Fiscal 1958.**
- **July 15—AMC rescinds July 1 request, asks for forecast of billings for contracts with more than $5 million uninvoiced.**
- **July 20—Air Force presents schedule of end item production and scheduled acceptance dates. This was the first stretchout program in detail for aircraft and engine production. Forecast of billings revised to reflect this schedule was requested.**
- **July 25—Reduction of 5% in expenditures ordered by Air Force from funds available for aircraft and related procurement in "effort" type contracts where no hardware is involved.**
- **Aug. 8—Another telegram "rescinds" the July 25 instruction and promptly reinstates the same stretchout, adding funds for maintenance and operations. Contracts to be included or excluded are redefined.**
- **Aug. 13—Directive reduces ceiling on progress payments from 90% to 85% of direct labor and material costs and from 75% to 70% on total cost payments.**
- **Aug. 18—Reduction of at least 5% in all reimbursable expenditures must be made by Sept. 30 with the least possible effect on delivery schedules except for the "effort" type contracts covered in the July 25 and Aug. 8 instructions. Also exempted are contracts financed from research and development funds and contracts stretched out by the July 20 order.**
- **Aug. 23—Research and development funds for specified contracts are reduced by 5%.**
- **Sept. 11—Major contractors meet with Air Force Under Secretary Malcolm A. McIntyre and Lt. Gen. Clarence S. Irvine, deputy chief of staff for materiel. Purpose is to discuss expenditure controls and contractor forecasting to avoid unnecessary revisions and minimize impact of necessary revisions.**
- **Sept. 27—Air Force places a dollar limit on payments to major contractors for the months of October, November and December and for the first two calendar quarters of 1958. The letter stated: "It is essential that your current schedules be maintained to the maximum possible degree within these limitations. . . . While in some cases it may be necessary to adjust production schedules as a result of these limitations, we would expect that full consideration would be given to reduction of in-process inventories, overhead and the financing of a higher percentage of the work-in-process by your company for at least a limited period of time before proposals are presented to the Air Materiel Command for a reduction in the present delivery schedules."**
- **Oct. 1—Directive rescinds May 16 and June 19 directives on overtime. The changes are technical, stating that the overtime policy applies to all types—straight or premium. Procedure for obtaining approval for overtime is changed, and one condition for overtime payment will be "lower over-all costs to the government as well as reduced current payments." The goal is to slow current cash payments.**

USAF, Navy Deactivations

Washington—Deactivation of USAF and naval aviation units, forced by the current limitation on operating funds, will affect about 5,800 military and more than 400 civilian personnel. Some will be discharged, others shifted to new assignments to accomplish payroll cuts through attrition. Scheduled for deactivation are:

- **91st Strategic Reconnaissance Wing, Strategic Air Command, Lockbourne AFB, Ohio. Most officers and airmen will be moved to other SAC groups. Those due for discharge within a year will be released.**
- **96th and 97th Fighter Interceptor Squadrons, Air Defense Command, New Castle County Airport, New Castle, Delaware.**
- **12th Day Fighter Group, Tactical Air Command, Bergstrom AFB, Tex.**
- **21st Helicopter Squadron, Tactical Air Command, Donaldson AFB, Greenville, S. C.**
- **57th Air Transport Squadron, Military Air Transport Service, Kelly AFB, San Antonio, Tex.**
- **22nd Air Transport Squadron, MATS, Charleston AFB, S. C.**
- **35th Air Transport Squadron, MATS, Charleston AFB, S. C.**
- **Naval Air Station, Naval Air Reserve Training Command, Lincoln, Neb.**

of them will suffer contract cutbacks.

One of the important problems facing USAF in this situation is the frequent unreliability of estimated billing figures submitted by contractors. There are cases in the first quarter of Fiscal 1958 where the billing estimates were nearly 100% higher than forecast. In general, the major, reliable contractors are submitting reasonably accurate data to help USAF in its financial planning. But there are a number of firms where the forecasts are consistently wrong.

Lack of accurate information of this type last week led to confusion in circles outside the Pentagon. Banking experts and some spokesmen within the aviation industry professed to be confused and totally incapable of measuring the magnitude of the industry's problem under the new ceilings.

Contractors' Reaction

A number of contractors queried by AVIATION WEEK said the limit imposed on their billing for the rest of the year is substantially lower than that justified by the contract. The frankest of them said they did not look on the USAF letters from AMC and Air Force Secretary James H. Douglas as a request for deferred payments.

The net effect, they said, is a stretchout of work to meet the new payment limits.

Bankers expressed concern over the possibility that progress payments will be revised downward again, along with a slowup in the payment of bills sent to the government. Some said they would not hesitate to finance aircraft and component makers with sound credit, but that providing money for a decreasing business operation will have complications.

More optimistic financial observers pointed out that bills unpaid by the U. S. government remain a sound security and that during the last war some contractors borrowed sums more than 20 times their net worth.

Others cited the fact that machinery still exists for the floating of V-loans—guaranteed by the government—although most banks and borrowers prefer to avoid the resulting complications and higher interest rates.

BuAer Pattern

Navy's Bureau of Aeronautics did not send letters to its contractors after the Air Force pattern. Major weapon system builders were summoned to Washington for conferences at which the limitations were discussed, and BuAer disclosed how much money it has available for each contract.

The conferences lasted through last week, and a decision on the extent of Navy contract cutbacks is expected next week. A high-ranking Navy spokesman told AVIATION WEEK that Bureau of Aeronautics has serious reservations about the ethics of seeking contractors to accept delayed payment of invoices. BuAer is embarrassed by the situation, just as it has been in past years by the fact that it usually ended the fiscal year with a substantial unexpended balance which resulted in sharp questions from congressional committeemen.

Burden of interest charges on loans was a matter of concern to both Navy and USAF contractors. One large company's spokesman said that, if it were to provide financing in order to prevent a production stretchout, the firm would be "loathe to do so without higher profit margins."

In another case, a company reports its profit on net sales has declined in the past year from 3% to 2% and still is headed down. It anticipates paying 5½% interest if it borrows to permit delivery on schedule regardless of the customer's ability to pay.

It was evident last week that there will be no uniformity to the 14% overall slash in production for USAF. Some firms, particularly one in the avionic field, expects a cutback ranging from 25 to 50%. A major aircraft manufacturer is preparing for a 23% reduction. Others, to achieve the balance at 14%, will be stretchedout to cut receipts by 5, 8 and 10%.

Avionics Cost Is 26% Of Ballistic Project

Los Angeles—Avionics manufacturers developing radio and inertial guidance for Air Force ballistic missiles spent nearly $175 million in Fiscal 1957 or 26% of the total expended on the missiles, excluding ground handling and support equipment. Air Force has obligated a total of nearly $600 million for ballistic missile guidance systems.

Figures were revealed here by Brig. Gen. Ben I. Funk, Deputy Director for Ballistic Missiles, Air Materiel Command, speaking to the West Coast Electronic Manufacturers Association.

Gen. Funk reported that since 1954 Air Force has invested nearly $200 million in facilities for ballistic missile contractors. Two guidance system contractors have invested nearly $20 million of their own funds for facilities.

High-speed communication and electronic data processing center will be used to speed handling of ballistic missile logistics problems and to provide up-to-date operational data.

Pointing to the growing complexity of weapon systems, and the fewer number of such contracts awarded, Gen. Funk told WCEMA that its members must adjust their developmental efforts and potential to missile sub-system work. He also cautioned that the ballistic missile program requires an order of avionics reliability "never before attained."

New Switching Transistor

Thyristor, new type transistor for high-speed computer flip-flop use, which can be switched "on" or "off" in 50 microseconds by reversing polarity of low-energy pulses applied to its base circuit, has been developed by Radio Corporation of America. Name is derived from the fact that tramistor bears some operational resemblance to the thyratron switching tube.

Thyristor reportedly requires sustaining voltage of only 0.5 v. at 100 ma. to remain in the "on" condition, has a reverse current of only two microamps in the "off" condition. Device does not require complex switching circuitry and is fabricated by conventional diffusion and alloy techniques, RCA says. Thyristor still is in development stage.

ECONOMY IS A WEAPON—National defense must fit the national pocketbook. Now, more than ever before, each element must be weighed against its cost. Northrop Aircraft's budget-minded management is continuing to use technology to achieve low-cost solutions to defense problems. This program brings results in weapons like the Snark SM-62, America's first intercontinental guided missile, the Scorpion F-89 all-weather interceptor series, the Radioplane Division's low-cost target drone and missile systems, and the Anaheim Division's ground-handling equipment, missiles and ordnance products. Latest example of this forward thinking is Northrop's new supersonic T-38 jet trainer airplane, a lightweight, economical member of an entirely new family of military aircraft which reverses the trend of rising costs. The T-38 can save hundreds of millions of tax dollars, and help provide the free world with the weapons of powerful military strength and vigorous economic solvency.

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Funds Preclude ICBM Defense for Cities

Washington—U.S. cities will not be defended against the Soviet ICBM under present plans of the Department of Defense. Both of the competing anti-missile missile systems currently being developed, Army's Nike-Zeus and Air Force's Wizard, are considered too expensive for this.

Administration and USAF planners reportedly have accepted conclusion of a Rand Corp. air defense study that the nation's missile defenses should be concentrated to defend bases of the Strategic Air Command rather than metropolitan areas because of the fiancial limitations of present and anticipated defense budgets. Purpose of defending bases is to protect SAC's status as a deterrent to aggressors.

Major U. S. cities presently are defended by batteries of Nike-Ajax ground to air missiles. Nike-Ajax has a range of about 20 mi. and is ineffective against even modern jet bombers. Nike-Ajax missile is scheduled to be replaced by the 50-75 mi. Nike-Hercules which can be equipped with a nuclear warhead for increased effectiveness against jets but which is totally ineffective against missiles of the ICBM type.

Rand is a non-profit corporation organized as an extension of USAF's Air Staff to conduct independent studies and evaluations of strategic and tactical problems in such areas as air defense.

SAC has 37 bases in the continental U.S. now, about a dozen overseas, and is planning to build more. Missile defense systems, however, reportedly are planned only for major bases.

Rand has done an exhaustive analysis of the problems of defense of the U.S. against ICBMS and against IRBMS that could be launched from submarines. Based on the premise that the national defense budget will continue at the same proportionate level, Rand found that the enormous costs of missile defense systems would preclude defense of any significant number of U.S. cities.

This is because both major anti-missile missile systems under development, Nike-Zeus and Wizard, must be placed close to target of incoming missile to be effective and can therefore protect only a limited area.

By effective protection of the operational bases of SAC, the Rand proposal would attempt to restore the "pistol to the head" stalemate, where a known aggressor would suffer immediate retaliation.

Problem of this type of defense, however, would be to identify accurately the aggressor should the Soviets decide to "share" their long range missiles with their allies.

Mission of an anti-missile weapon system is to detect, identify, intercept and destroy an incoming enemy missile. General characteristics of an enemy ICBM would be: range about 5,000 mi., flight time approaching 30 min., velocity at burnout about Mach 20, altitude at apogee (highest point of its elliptical trajectory) between 600 and 800 mi. Requirements of the system:

• **Detection** incoming enemy missile must be detected at great enough range to provide time for the tremendously complex missile defense system to track the intruder, compute its trajectory, arm and launch anti-missile missiles. Magnitude of the detection problem can be seen from the fact that an approaching ICBM will have a probable effective radar cross section of about 0.25 square meters but must be detected between 1,000 and 3,000 mi. away.

• **Identification** inherent part of detection is identification of the intruder as a missile rather than a meteorite or a decoy. An enemy multi-stage ICBM could release several light, simple decoys with the warhead of the final stage. These decoys could provide a better target for the tracking radar than the warhead, so the radar must be capable of distinguishing between them.

• **Interception** problem of computing the trajectory and velocity of an intruding missile once it has been detected and is being tracked requires a computer about the size of an IBM 704. With the present state of the art the only method by which a reasonable probability of interception can be obtained is to launch the anti-missile missile against the intruder on its own trajectory. This requires locating missile defense systems at each target area to be defended.

The anti-missile missile is tracked by a guidance radar from launch, and small corrections in flight path furnished by the computer during initial flight. Constant readiness required of the defense system dictates use of a solid fuel rocket.

• **Destruction** anti-missile missiles will be equipped with nuclear warheads. Present philosophy points toward smaller, more maneuverable missiles with lighter warheads. Because of the relatively low kill probability of such missiles, it may be necessary to fire 10 to 20 anti-missile missiles to kill one intruding ICBM.

Army sponsored anti-missile missile program is Nike-Zeus, an adaptation of Nike-Hercules. Nike-Zeus is the farthest along of any missile defense system. Douglas has produced mockup of the airframe, is working now to increase originally proposed 100-200 mile range. Bell Laboratories is contractor for target acquisition, guidance and computer systems (AW Oct. 7, p. 29).

Army sources say that Nike-Zeus program is lagging far behind in the race to have an operational anti-missile at the time Russia has a production ICBM. Reason, they say, is lack of funds.

Air Force missile defense system is Wizzard, under development by Convair and RCA. Proposed missile has a range of about 1,000 mi., is solid fuel, and is not an adaptation of an existing missile. Air Force program is broad, includes component development of special antennas, electronic antenna steering devices, high power sources, etc. Three Phase I studies of the missile defense problem have been completed under USAF contracts. Contractor teams are: Convair-RCA, Lockheed-Raytheon, and Douglas-Bell (same team as for Army's Nike-Zeus).

Air Force considers its system much more sophisticated than Army's Nike-Zeus but is far behind it in development. Wizard system, excluding certain special components, is far from completion of even the planning stage.

A third project, called Plato is scheduled to be canceled. Plato was originally studied competitively by both Cornell Aeronautical Laboratory and Sylvania, but Cornell project, the more sophisticated of the two systems, was canceled last September. Plato has been supported by both Army and Air Force.

Navy is interested in an anti-missile missile system for fleet defense but so far has confined itself to studying systems based on modifications of Talos shipboard to air missile.

Problem in the detection of missiles at very long ranges about which little is known is effect of the aurora borealis or "northern lights" which may reflect radar signals. Aurora is caused by streams of ionized particles from the sun as they encounter the magnetic fields of the earth.

Last week, a joint U.S.-Canadian project was announced to discover the effects of the aurora on radars that will be used for detection of enemy ICBMs. Sponsored by Canada's Defense Research Board and USAF, project will be manned by Canadian scientists and scientists from MIT's Lincoln Laboratary. Research station will set up this winter in Northern Saskatchewan.

Ionization of the atmosphere by an incoming ICBM warhead may be useful for the detection of the warhead during later stages of its flight. Little enthusiasm has been found for this technique, however, because warhead does not cause heavy ionization of the atmosphere until it is within about 100 mi. of its target.

TWA Forecasts Jet Costs, Operations

Turbine era can mean big profit—or economic disaster if timetable race begins, airline committee warns.

By Glenn Garrison

New York—To get the best out of their jets from a cost standpoint, airline managements will have to avoid uneconomic speed competition in scheduling the planes, Trans World Airlines officials were advised last month by their jet planning committee.

The committee warned that a timetable race could be costly for everybody because of the jet's demand for precise planning to achieve financial success.

Direct operating costs of TWA's jets will go as high as $911 per hour, the planners noted, and inefficient planning and procedures could spell economic disaster.

Potential Rewards

On the other hand, TWA management was told, possible financial rewards of efficient jet operation are tremendous.

The committee, organized about a year ago to prepare TWA for integration of jets into its fleet, also reported during an all-day briefing that:

• **Convair 880 and Boeing 707-320** will have greater schedule reliability in hot weather than the Boeing 707-120. Thrust-limited 120 will suffer speed loss in summer temperatures whereas drag-limited 320 and 880 will not.

• **Long-range Boeing** may have to make fuel stops westbound between Paris and New York when winds approach 60 kt. and load exceeds 90 passengers. Eastbound transatlantic flights should be able to make it nonstop most of the time.

• **Convair and 320** lose 50% of payload on a 100 deg. day with length-limited runway. Boeing 120 loses only 20% of its payload under similar conditions.

• **With two sizes** of medium-range jet aircraft, TWA can achieve scheduling flexibility tailored to the traffic situation on a particular route.

• **Direct seat-mile** costs of the jets will be as much as 30% less than those of Lockheed 1049G Super Constellation.

• **Minimum cost speed** of the jets will be Mach .82. Operating on either side of this low cost point increases costs per mile as much as 6-7 cents.

• **Wide variance** of needed runway lengths with different payloads and ranges will pose a problem in defining runway requirements. If airlines ask for minimum runway, too much offloading will result; if they ask for too much runway, landing fees may be too high.

• **Airport facilities** at 40% of the cities served by TWA may not be satisfactory for best jet use during at least the first year of their operation.

• **Fuel costs** of jets will be 40% of total direct costs, compared to 32% for today's piston planes.

• **Breakeven passenger** load factor of the Boeing will be 55% compared to 75% for the piston 1049G, assuming a fixed percentage for overhead.

TWA's Boeing 707-120, which the airline has designated 131, will lose cruising speed at the high temperatures that occur 50% of the time on TWA's routes in the summer, the committee reported. This speed loss must be taken into account in schedule planning.

The Boeing 707-320 (called 331 by TWA) and Convair 880 can be scheduled 29 kt. faster than the 120 because, not being thrust limited, they pick up cruising speed in hot weather.

This hot-day speed edge over its own and competitive small Boeings could be increased to 54 kt. for the 880 and 39 kt. for the 331 under highspeed cruise conditions, the committee noted. However, flying the jets at maximum cruise power would be costly, and uneconomic speed racing should be discouraged by airline management.

The Convair and big Boeing can be operated at minimum cost speeds at all times, whereas the 120 will cost relatively more to operate in summer temperatures. TWA is discussing with Pratt & Whitney the means of increasing cruise thrust of the J57 in order to improve its ability to provide minimum cost speed.

Altitude as well as speed will be a vital factor in operating jets at their maximum economy levels, the committee said. Costs decline with each step of altitude, and loss of speed is offset by fuel savings. The jet has a minimum operating cost for each altitude and a minimum cost altitude for each trip.

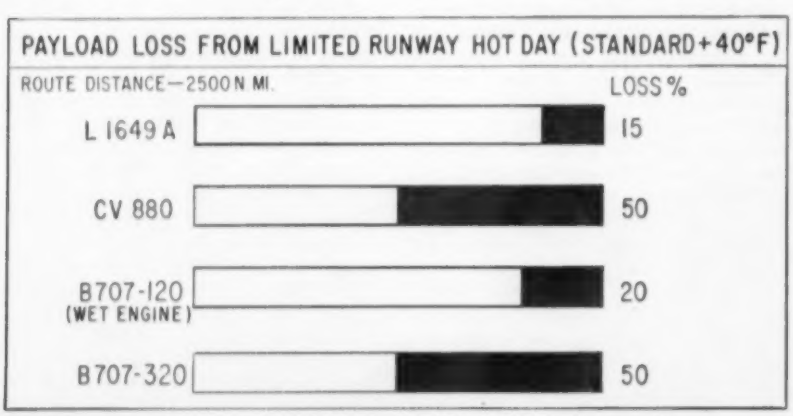
Economy Speed

No more than seven minutes will be added to the average schedule by the slight speed reduction necessary for maximum economy. If procedures are geared to the best cost speeds and altitudes, TWA will save $2.5 million annually in operating costs, the committee estimated.

Because of the importance to a jet of runway lengths, TWA's engineers worked with the aircraft and engine manufacturers to improve thrust and cut down airport limitations at high altitude, hot weather fields as Denver, the committee reported. The Convair needed thrust improvement because of weight increases, and this has been accomplished. Improvement in the Boeing 320, powered by the Pratt & Whitney J75, is expected in this area.

The General Electric CJ805-3 engines in the 880, according to the committee, now permit a runway length reduction from 7,600 ft. to 6,300 ft. with the same payload and range.

Piston planes, the committee said,



TWA figures support contention that economy is important to jet operation.

require takeoff distances up to 6,100 ft. on standard days and need increases of only 7% on 100-deg. days. Jets at maximum weight need field lengths of 7,600 ft. to 10,000 ft. and these lengths increase from 11% to 35% on hot days.

The Boeing 120, with a wet engine capable of maintaining its thrust to a temperature of 92 deg., needs only 11% more runway on a 100 deg. day. The Convair's engine, augmented by increased turbine rpm. and turbine temperature, is less affected by temperature than the Boeing 320's engine, which is unaugmented and loses thrust at a rapid rate.

Whereas the 1649A loses only 15% of its payload on a 100 deg. day and a limited length runway, the Convair and 320 lose 50% and the Boeing 120 loses 20% of payload near maximum range conditions.

Suppressor Loss

These figures, the TWA committee pointed out, are the airline's own and are about 9% higher than the manufacturers' estimates. None of the manufacturers, according to TWA, are correcting takeoff distance for the thrust loss caused by sound suppressors. And TWA said, "we also evaluate the manufacturers' estimates to determine the degree of optimism and whether the manufacturer is likely to demonstrate distances at the extreme tolerance of their guarantees."

Much jet planning is based on the assumption that airport facilities can be brought up to standard, according to TWA's planners. They predict, however, that only 60% of the cities served by the airline will have satisfactory "ports" for jet aircraft when they arrive on the scene. The remainder will lack either suitable runways, passenger handling facilities, gate positions or the like for most efficient use of the jets.

"We'll operate, and we ought to be able to make it," Robert N. Buck, special advisor to TWA President Carter Burgess told AVIATION WEEK. "But the industry would be a lot surer if we knew the facilities were going to be available."

Big problem is who will pay for the expensive new airport facilities needed for the jet operations. If they are not provided somehow, jet operations may be restricted below their potential—for example, nonstop service may in some cases give way to flights with scheduled stops.

Wind has relatively little effect on a jet's operating time because it is a much smaller percentage of cruising speed, but it substantially affects the jet's payload. A Paris-New York Boeing 331 flight against a 60-kt. wind can lose 13,500 lb. of its 32,000-lb. payload to extra fuel. Fuel variance on a transcontinental flight can reach 10,500 lb., depending on wind, temperatures and altitude.

Higher operating altitudes and release procedures, however, can increase payload or nonstop reliability.

The wide variance in takeoff weights, and hence needed takeoff distances, will cause a problem to airlines in defining their runway length requirements, the committee predicted. A balance between runway costs and lengths must be attained which will permit takeoff with enough fuel to permit most operations if speed and altitude are varied. Offloading because of airport temperatures must not occur more than once in 500 flights, the committee believes.

Use of both Boeing and Convair jets will provide TWA with excellent scheduling flexibility for best cost operation, the committee reported. For example, the 880 can break even with two schedules a day on a route providing 100 passengers a day. Two Boeing schedules on the same route would lose money, while one Boeing schedule would reduce the frequency of service.

On a denser route with 150 passengers daily, two Boeing schedules could operate at profitable load factors where three Convair flights would be needed. In some cases combinations of Boeing and Convairs might work out best economically.

Profit-Loss Margin

The big margin of profit-or-loss the jets will provide is illustrated by the fact that for 1 million airplane miles, 5% of passenger load factor is worth about $333,000, or $154,000 more than for the 1049G. for 15 Boeings, the

Cruising Speed vs. Outside Temp.

(30,000 feet)

	Convair	Boeing	
	880	120	320
Desired Cruising Speed, Standard Day (kt.)	477	477	477
Result Speed, Hot Day (kt.)	492	463	492

Operating Cost as a Function of Total Direct Cost

	Convair	Boeing		1049G
		120	320	
Crew Salaries	9%	8%	8%	13%
Insurance	6%	6%	6%	6%
Fuel	41%	40%	37%	32%
Maint. & Overhaul	25%	26%	28%	19%
Depreciation	19%	20%	21%	30%
	100%	100%	100%	100%

Direct Operating Cost—Jet Versus Piston

(Domestic) 750 Mile Average Trip

	Convair	Boeing		1049 G
		120	320	
Total Cost	$693	$853	$911	$386
% Increase Over 1049G	180	220	236	

Operating Cost—Jet Versus Piston

Unit Cost	Convair	Boeing		1049G
		120	320	
Per Airplane-Mile	$1.54	$1.93	$2.10	$1.49
Per Seat-Mile in First-Class Service	1.92	1.68	1.68	2.40
Added Passengers Required to Equal 1049G Results if Indirect Is 90%	15	16	20	.....
Passenger Load Factor Required to Break Even Excluding Cargo	62%	57%	55%	75%
For Every 1,000,000 Miles 5 Percentage Points of Load Factor	$232,000	$333,500	$362,500	$179,800

committee notes, this adds up to $6 million per year—"to the good or to the bad."

While direct seat mile costs of the jets are down as much as 30% from the 1049G, the Boeings will require 16 to 20 more passengers per mile to equal the Super G's cost results. The 880, according to the committee, will need only 1½ more passengers per mile to achieve the same.

Unlike piston planes, which generally operate most economically at maximum cruising speed and optimum altitude, the jet airplane likes a speed somewhat less than maximum. Costs for all expense items except fuel diminish as speed rises, but cruise above the drag rise Mach number boosts thrust requirements to the point where fuel costs per mile climb rapidly. Minimum cost speed of the jet occurs at all altitudes around Mach .82.

New concepts of flight planning and procedures will be reflected in jet operations, the committee said. TWA is developing flight planning charts to aid the planning.

Generally, Boeing 707-120 flights will be geared to highest altitudes where best airspeed can be maintained. Maximum cruise power will be used on initial stages.

Higher or lower altitude than optimum may be selected in some long range operations to reduce cruise speed for fuel conservation. Minimum cost speed, the committee notes, is faster than long range speed.

To avoid holding at the end of runways, where an idling 120 will burn 4,400 lb. of fuel an hour, TWA hopes to keep its jet flights at the passenger loading ramp until 15 minutes before takeoff time. When a plane is loaded and ready to start engines, it will call the tower for takeoff sequence.

Tower Cooperation

The committee points out that such procedure will require cooperation of air traffic control, the tower and other airlines, and that it would tie up gate space at busy periods. Alternatives include increased fuel reserves and engine time, or intermediate holding areas equipped with ground support equipment. TWA does not plan to tow its aircraft out to the runway.

The alternatives are undesirable, the committee feels, and a better solution is needed by the industry. The problem is being considered by Air Transport Association operations committees, but nothing better has turned up yet.

TWA's committee hopes for great improvements in air traffic control system, but "is not so optimistic as to expect no complications" in handling of the jets.

Members of the committee presented TWA management with a mockup schedule of the first commercial transcontinental jet flight by the airline in May, 1959.

Among the details:

• **Flight 712-28,** a Boeing 707-120, is scheduled to depart Los Angeles at 1700 Pacific Time, arrive New York International Airport 4 hours, 45 minutes later at 0045 Eastern Time.

• **Trip fuel** for the flight is 55,600 lb., plus 6,000 lb. of water for engine augmentation during takeoff and initial climb. Gross weight is 236,000 lb. limited by the allowable landing weight of 175,000 lb. at Idlewild. The planned 10,000 ft. plus runway at Los Angeles, with 62 deg. surface temperature and with 10 kt. wind, requires no takeoff restrictions at this weight.

• **Plane takes off** in 7,500 ft. of the 9,100 ft. required runway length. Takeoff speed is 153 kt. Climb to 10,000 ft. is accomplished in seven minutes, to 31,000 ft. in 28 min. Climb is made at normal rated power at best climb speed of 300 kt. indicated airspeed, which is 425 kt. true airspeed at 31,000 ft. Takeoff and climb reduce gross weight by 17,200 lb.

• **Flight 712** cruises at 31,000 ft. along Victor airways. Mach .81 is minimum cost speed, equals 478 kt. TAS with the outside air temperature of minus 52 deg. fuel consumption during cruise is about 12,000 lb./hr.

• **Over Idlewild** the flight has enough fuel to hold for 59 minutes, miss an approach, climb back to 30,000 ft., proceed to its alternate, Pittsburgh, take 15 minutes for approach, and land with 45 minutes of fuel remaining.

• **At 30,000 ft.** over Idlewild, the plane holds in a two minute race track pattern 18 miles long and seven miles wide. Most efficient configuration is clean, with flaps and gear up and airspeed at 200 kt. indicated. Plane could hold in smaller pattern now used by piston planes if flaps were extended and speed reduced to 160 kt. But this procedure would increase fuel consumption by 38%.

• **Bottom of the jet stack** is probably at 20,000 ft. Descent from that altitude is made with power back, gear down, speed brakes on, at a rate of 4,000 fpm. at 270 kt.

• **Flight lands** at Idlewild at 172,000 lb. gross weight, requiring 6,500 ft. of runway. Touch down to stop distance may be only 4,000 ft.

Trans World's jet planning committee is supervised by Buck. The committee is composed of a chairman, a coordinator and representatives from each department of the airline. Planing and integration costs are budgeted by the respective departments.

When the committee was organized, its members "sat down and figured out everything you could run into in jet operation," Buck reported. Then they boiled the items down to 250.

After each departmental representative came up with information, the committee set up a timetable for action on the items. Some items, such as ordering maintenance parts, already have been checked off.

Committee members now are being pulled out of their departments for full-time work on jet integration, Buck reports, "as the hour approaches" for first jet operations.

The New York session during which the committee's report was made was attended by Burgess, members of TWA's Board, and other executives.

Northwest Charges Favoritism By White House in Circle Case

By Ford Eastman

Washington – Northwest Airlines charged the White House last week with ignoring the Civil Aeronautics Board and favoring Pan American World Airways in decisions regarding the Transpacific Route Case.

In a petition filed with the CAB, Northwest said President Eisenhower has overruled Pacific air route recommendations made by the Board five times since December, 1954, each time to the benefit of Pan American.

At the same time, Northwest questioned the validity of a CAB order issued last month at the President's request. The order vacates a decision approved by the White House in August which denied Pan American traffic rights at Portland and Seattle on the Great Circle route and defers final decision.

The airline contends there is no legal procedure that permits reversal of action once taken and published by a government executive officer.

The petition also asked the Board to take the necessary steps to assure that the President is fully and accurately advised as to the full economic implications of his actions on the basis of the most recent data of record. It said:

"If the President is to make economic judgments in the difficult area of international route patterns, sound government requires that he be primarily guided by the agency with both the facilities and the expertise to give him the maximum objective assistance. This means that the Board itself has an affirmative responsibility to see that its

views on these economic matters are fully known to the President personally.

"This requires not only a presentation of facts but an evaluation of their significance and a firm recommendation. If the Board does not aggressively assume its full responsibilities, the President may be left with incomplete or unevaluated information supplied outside of the official Board record by partisan advocates of parties to the cause."

Northwest contends that at no time between the President's decision of Aug. 2 and his reversal of Sept. 3 did the CAB present any new economic facts or recommendations to the White House. "Thus," the airline said, "it is apparent that whatever data came to the attention of the President between Aug. 2 and Sept. 3, causing the reversal of the Board's decision, was made by ex parte data presented by Pan American or individuals supporting its position."

Proteus Engine Speed Restricted by British

London—Britain's Air Registration Board has advised Bristol Aeroplane Company and BOAC to limit compression speed in Britannia's Proteus 705 and 755 engines to 11,350 rpm.

This restores the situation of last month before the Proteus 705 was re-rated to allow 11,500 rpm. and the Proteus 755 to 11,725 rpm. (Except at temperatures above 35C where re-rated speed was set at 11,650 rpm.)

Air Registration Board says it has restored earlier compression speed rates as "precautionary" measures only and that the recommendations do not include withdrawal of the Britannia's certificate of airworthiness.

Guest Recommended For Miami Schedule

Washington—Guest Aerovias Mexico has been recommended by Civil Aeronautics Board Examiner John A. Cannon for a foreign air carrier permit for Route E under the U.S.-Mexican air transport agreement.

Guest already has been designated by Mexico as the carrier to operate Route E, which goes from Mexico City to Miami and beyond via intermediate points in Mexico.

The foreign air carrier permit will authorize the carriage of passengers, mail and property between Mexico City and Miami and between Mexico City and terminal or intermediate points of Lisbon, Madrid, Paris and London, via intermediate points of Miami; Hamilton, Bermuda Islands, and Santa Maria, Azores Islands. The application for the permit still must be decided by the Board and the President.

House Committee Charges CAB Blocked Investigation Attempts

Washington—Civil Aeronautics Board is being charged by a special subcommittee of the House Commerce Committee with attempting to pull down an "Iron Curtain" on a congressional investigation into two highly controversial route cases:

- **North Atlantic Case,** involving the $17 million sale of American Overseas Airlines, an American Airlines subsidiary, to Pan American World Airways, decided in 1950 under the Truman Administration.
- **Great Circle Case,** involving the Pacific area routes of Pan American and Northwest Airlines. The case has been in process since 1954 under the Eisenhower Administration.

Why the Investigation

Crux of the investigation, launched by the special subcommittee headed by Rep. Morgan Moulder (D.-Mo.), is to determine the extent of White House influence on the Board's quasi-judicial decisions.

The subcommittee requested access to CAB files on the North Atlantic Case for the year 1950 and on the Great Circle Case for the period from Jan. 1, 1954, to Sept. 13, 1957.

A staff notice issued by the Board on Sept. 30 detailing the extent to which cooperation should be given congressional investigators touched off the subcommittee's charge. Moulder declared that the notice "is without basis in precedent or law" and tantamount to a "refusal" to permit the subcommittee to make its investigation.

"The Board's action can have only one meaning," Moulder charged. "Either CAB feels that it has something to hide, or it is manifesting an arrogant disregard of the authority and duties of the Congress."

Specifically, Moulder objected that the Board had directed the withholding of "any communications or memoranda among Board members or between members and their assistants; any communications between the CAB and the President, his immediate staff, the State Department or other executive departments and agencies relating to foreign cases; and the personal files of Board members."

These restrictions, he objected, would limit the subcommittee's investigation to "various routing and presumably innocuous lower-echelon correspondence and memoranda files and public dockets."

Furthermore, CAB's proposed plan to "censor" and "doctor" files, Moulder added, would leave the subcommittee "completely in the dark as to whether its investigations and hearings were upon the basis of an incomplete and distorted record; it would place the Board or some subordinate staff employe in a position of unchecked license to remove from any file any document deemed embarrassing without reference to any standard at all."

Demanding that CAB rescind the staff notice, Moulder set a public hearing for Oct. 17 with Board members.

The White House changed CAB decisions in both the North Atlantic and Pacific cases. CAB voted three-two against the American Overseas-Pan American merger but was directed by President Truman to issue an order reversing this position. Joseph O'Connell, then CAB chairman, resigned. Russell Adams, now a Pan American vice president, was not reappointed as a Board member. O'Connell and Adams had led the Board's opposition to the merger.

President Eisenhower has reversed five CAB decisions on aspects of the Pacific case (see page 40). One White House reversal, involving the Portland-Seattle to Hawaii routes of Northwest and Pan American roused such vehement congressional protests that the reversal was rescinded (AW Feb. 14, p. 12).

Proposed Legislation

The development also spurred the Senate to approve legislation eliminating White House participation in overseas route cases and strictly limiting its participation in foreign route cases to national defense and foreign policy considerations—and these would have to be justified in reports in the Congress.

Senate Commerce Committee again approved the legislation this year. The Moulder subcommittee investigation is expected to build up House support for the measure. It is strongly opposed by the White House and the State Department.

In its report, Senate Commerce noted that an applicant rejected by CAB "may press his suit anew at the White House, and . . . need not even frame his appeal in terms of a defense or foreign policy issue."

The Moulder subcommittee was formed to review the activities of all quasi-judicial regulatory agencies under the sponsorship of Rep. Sam Rayburn (D.-Tex.), House speaker. There is widespread congressional criticism that, through the power to appoint members and other pressures, the White House is dominating these independent agencies.

Automatic Traffic Control Plans Detailed

By L. L. Doty

Indianapolis—Civil Aeronautics Administration will take the first step toward automatic traffic control next spring in a program designed to reduce manual processing of flights by 83% in time to cope with the large influx of jet transport.

First stage of the overall program includes introduction of Univac file computers at New York and Washington air route traffic control centers early in 1958. The move will cut the 5,400 data processing operations in each of those locations from 100% manual to 61% manual.

Through its Technical Development Center at Weir Cook Airport here, CAA already has placed an International Business Machine 650 computer into service-test operation at the Indianapolis center and has sliced the time required to process one flight from four minutes to 20 seconds. The Univac has been selected to replace the 650 computer because of its capabilities for on-line communications and expandable storage.

Here are the key points of the program designed to bring automatic data processing to air traffic control for the first time:

• **Univac computers** will be used initially only to process flight data and distribute the original flight process. Input-output data will be handled manually in the first stages of computer use. Early in 1959, computers will be added to five other centers in addition to those at Washington and New York.

• **Communications link** to provide automatic capability of direct on-line transmission of data between computers in adjacent centers is now under development here. This step will reduce manual operations to 56% and increase automatic functions to 44%.

• **Direct input of flight data** from an outlying station into the computer will be accomplished with a device known as Fliden (flight data entry). Prototype model is expected to be delivered to Technical Development Center TDC in March. Following prototype development, an evaluation program scheduled to last about three months will begin in early 1959. Introduction of this equipment will increase automation to 50%.

• **Automatic tabular displays** and a controller's input device will bring automatic control of traffic up to 83% when introduced in late 1959. The input device which enables the controller to introduce reports into the computer for automatic processing is now under development at the center. It will become available when the computer systems become fully operational. Although several types of automatic tabular display equipment are being studied, TDC has not yet decided whether to use the direct-view cathode ray tube or a projected display.

• **High speed data transfer** communications equipment may be necessary to prevent delays in moving information from one center to another during peak traffic loads. Specifications will be written for such equipment which is expected to be available for testing in 1959.

As part of its long-range air traffic control program, CAA will install air traffic control radar beacon system ground units at nine sites in the New York, Norfolk, Washington and Chicago areas next year for service environment tests. Approximately 187 aircraft will be equipped by commercial airlines with transponders to permit service-testing of the units.

Technical Development Center plans to dove-tail in-service improvement programs with the implementation of the system in order to expand the utility of the system as operational experience is gained. In addition, ground equipment designed specifically for air traffic control use may not be available at the time of implementation.

In this connection, the center is calling for an improvement in present interrogators. It also needs equipment dualization and monitoring provisions to increase reliability. To prevent display clutter, TDC says development and devaluation of beacon-video defruiting is required for use when airborne equipments respond to several ground stations.

Further deficiencies in the radar beacon system lie in the limited operational utility of present ground decoders. The center wants to see the development of flexible multi-channel decoders for display filtering purposes and read-out decoders to accelerate identification.

To alleviate system capacity and azimuth resolution problems, TDC is calling for the development and evaluation of side-lobe suppression systems. One system, developed by the Cossor firm in England will be evaluated at the Naval Air Test Center, Patuxent River, Md. Another system, developed by Stewart Warner Corp., is to be evaluated at Technical Development Center.

Here is the TDC time schedule for development and evaluation of secondary radar:

• **System implementation** and in-service improvement of the system will begin next year.

• **Evaluation of beacon-video** defruiting equipment will begin in 1958 with implementation expected to follow in 1959.

• **Implementation** of a ground antenna system is scheduled for 1960 following development and evaluation during the next two years.

• **Multi-channel** and active read-out decoders development will begin next year. Implementation will probably begin in mid-1959.

• **Development of prototype side-lobe** suppression systems probably will not begin until 1959 following evaluation of the Cossor and Stewart Warner systems.

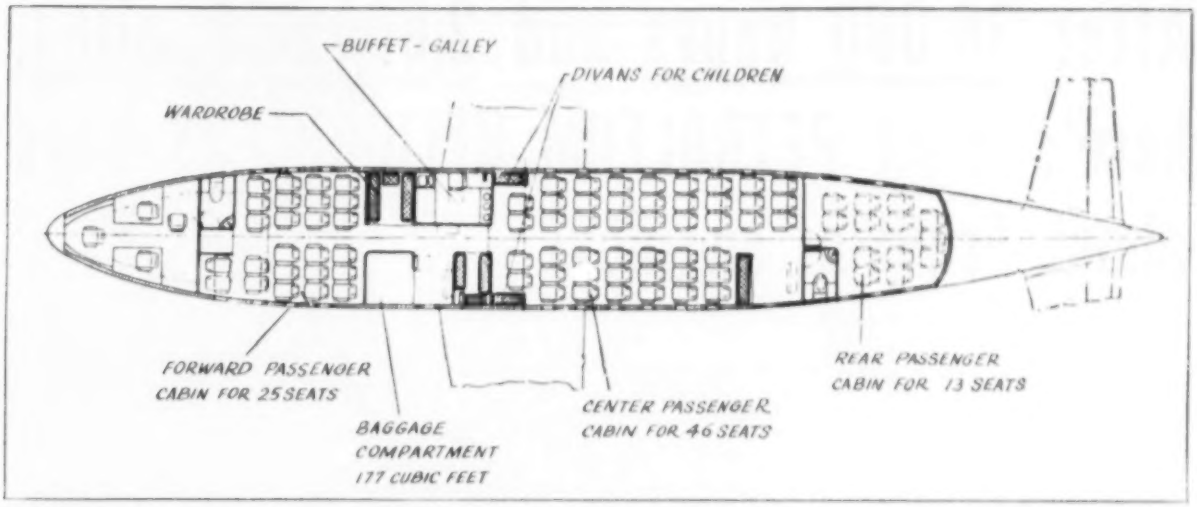
Evaluation of improved radar displays is a major part of Technical Development Center's work to simplify the controller's job and accelerate the flow of traffic. CAA is not satisfied with the standard 10-to-12 inch direct view radar indicator particularly when used with long-range radar.

Specifically, the agency is seeking bright displays which can be read under daylight conditions with better "trail" or history information to assist in initial identification. At present, Technical Development Center is evaluating scan-conversion equipment produced in France for the French navy (AW March 25, p. 34). This equipment converts the radar information to a TV-type signal and then combines the radar information with signals from a TV camera mounted over a plotting board.

The combined picture is then displayed on a conventional TV receiver. TDC has found the tube which is used in the conversion process to have excellent storage characteristics. According to TDC engineers, the equipment, known as Type T-1-440, may be the solution to getting a bright ATC display with adequate trail.

Another type of equipment undergoing study at the Indianapolis center is the British-made Kelvin-Hughes radar projector consisting of a radar indicator, camera, rapid film processor and projector built into one unit. One rotation of the radar is photographed, and the film is developed and projected in about seven seconds. The equipment is used by the Royal Air Force in radar fighter command facilities and will be delivered to USAF shortly. Also under consideration is the Dumont SRD-1 which uses a special tube called the "graphecon" to convert the rho-theta scan of a normal radar display to a TV scan. Although the display is equivalent to a TV display in brightness, this scan-conversion system has insufficient dynamic range.

Radar indicators employing IATRON tubes are under investigation as well.


BUFFET - GALLEY
DIVANS FOR CHILDREN
WARDROBE
FORWARD PASSENGER CABIN FOR 25 SEATS
BAGGAGE COMPARTMENT 177 CUBIC FEET
CENTER PASSENGER CABIN FOR 46 SEATS
REAR PASSENGER CABIN FOR 13 SEATS

PASSENGER and crew compartments of Ukraina are pressurized with air bled from the engine compressors. Plane carries crew of six.

Soviet Ukraina Cuts Cost by 'Borrowing'

Moscow—Russia's new Ukraina turboprop transport makes extensive use of assemblies, parts, hardware and equipment from other aircraft already in production in the Soviet Union.

The O. K. Antonov Design Bureau, which developed the Ukraina, reports this procedure has cut manufacturing costs. Bureau is already at work on an improved version of the aircraft.

Aeroflot, the state-owned airline, adds that dirt and grass field operation was one of the prime considerations in the design of the Ukraina. Many of Aeroflot's operational fields are in this category. To suit the Ukraina to this use it has:

- **Low landing** and takeoff speeds.
- **Large low-pressure tires** and a total of eight wheels in the main gear.
- **High wing configuration** to keep the engines well above dirt fields.

The 84-passenger Ukraina is powered by four Kuznetzov 4,000 eshp. propeller turbine engines mounted in underslung nacelles on the wing. Engine mounts are made of steel. Propellers are four-bladed, full-feathering and reversible. Feathering is automatic.

Ukraina's Capabilities

Cruise speed varies from 373-404 mph. at altitudes from 26,250-32,810 ft. depending on gross weight. Normal takeoff weight is 112,435 lb. with a 28,660 lb. payload. Range with this loading is 1,242 mi. If the payload is cut to 22,046 lb., range increases to 1,863 mi., and if payload is lowered to 18,078 lb., the range becomes 2,174 mi. The aircraft can fly at 19,680 ft. on two engines, according to Aeroflot.

In general appearance the Ukraina resembles the newer U. S. military transport types C-130 and C-133. It has a high wing and a circular fuselage with the main landing gear housed in large external bulges so that the main cargo compartment is undisturbed by stowing the gear internally.

The two-spar wing is straight with a trapezoidal shape. It is made in five sections: a center panel, two middle panels and two outboard panels. All fuel is carried in the wings. The flaps are of the slotted type to give the best low-speed characteristics.

Control Surfaces

Horizontal tail of the Ukraina is all metal. Stabilizer is of two-spar construction and is made in two parts, each part attaching to a fuselage rib through large fittings. The two elevators have a single spar for the main member; each elevator is connected to a stabilizer at four points. Dual trim tabs are used.

The vertical tail is also all metal,

UKRAINA has circular fuselage. Main landing gear is housed in external bulges, leaving main cargo compartment undisturbed.

After 30,000 hours and 2,000,000 miles, here's what PETROLEUM HELICOPTERS says about Franklin engines:

Mr. C. L. Tysdal, our superintendent of maintenance, says he considers the Franklin one of the best light engines ever made.

Stan Clay, chief pilot of Petroleum Helicopters, has over 2,000 pilot hours in Bell helicopters powered by Franklin and says it is one of the most dependable engines he has encountered in his experience.

Our type of operation really gives an engine a workout, but it is a rare occurrence when a Franklin doesn't go the full 600 hours for a major overhaul.

The above are excerpts from a letter from Leon Boyd of Petroleum Helicopters, Inc.

Franklin

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OLEG K. ANTONOV, designer of Ukraina.

with a dorsal fin that has two spars. The rudder has one spar, and has three hinge points. A retractable stand, to prevent the tail from coming in contact with the ground during loading operations, is incorporated in the empennage.

Aeroflot reports that the Ukraina contains the latest radar and radio equipment to make all-weather flying safe. The aircraft's control surfaces are moved by an unpowered system of stiff rods. This conforms to what appears to be a basic Aeroflot policy of not using powered controls unless absolutely necessary.

De-icing equipment is described as electrothermal and extends to the wing, empennage, engine air intakes, oil temperature regulators, propellers and the glass in the pilot's and navigator's cabins. The leading edge of the empennage containing the de-icing apparatus is removable.

Accessory Power

Ukraina uses hydraulic and electric power to run its accessory equipment. The hydraulic system operates at about 2100 psi. and is split into two separate units. Each operates off engine-driven pumps and provides enough power by itself to keep all the accessory equipment working in an emergency. A manually operated pump is also provided to operate the system on the ground when the engines are not running.

In an emergency this pump can also be used to lower the landing gear.

Engine starting is accomplished by an electro-mechanical system, according to Aeroflot. The starting system is central and can start the engines in any sequence.

Passenger and crew compartments are pressurized with air bled from the engine compressors. Air pressure and temperature is regulated automatically. Sea level pressure is maintained up to an 18,000 ft. altitude. This pressure differential remains constant with further increases in altitude. Heated air is fed into the passenger cabins through louvers in the ceiling and is drawn out through vents in the floor and dumped overboard.

Flight crew consists of six people: pilot, copilot, navigator, radio operator and two stewards.

Passenger Compartments

Passenger cabin is divided into three salons. One holding 25 passengers is located directly behind the crew's compartments and is separated from it by a non-airtight partition.

Between the forward salon and the 46-seat center passenger cabin in the plane of the propellers is the buffet-galley, a place for hand luggage and the forward wardrobe. The buffet-galley, equipped to serve all the passengers one meal, has food refrigerating and heating equipment.

Rear passenger salon has 13 easily removable seats. They can be taken out and the compartment used for cargo.

Cabin Details

Passenger seats are joined in two- and three-seat blocks. They have adjustable backs in which radio headphones and individual lights are installed. An ash tray, along with radio tuning buttons, light switches and a steward call button, are located on the right arm rest of each seat. Light luggage racks have been installed above the seats along each side of the compartment.

There are doors for passenger entrance and exit along the left side of the aircraft, one forward of the wing and one aft. Two lavatories have also been provided, one forward and one aft.

Cargo space consists of two pressurized holds in the lower part of the fuselage under the passenger compartments. Loading and unloading of these areas is accomplished through airtight doors at truck-bed level on the right side of the fuselage. A baggage compartment is also located aft of the forward passenger salon.

Vickers May Build Short-Haul Viscount

Vickers-Armstrong is quietly doing a market survey on a new high-density short-haul version of its Viscount turboprop airliner, designated 796, aimed at 150-mi. stage lengths. At least one U.S. short-haul operator is interested, AVIATION WEEK has learned. Price would be approximately same as current Capital Airlines' Viscounts.

Viscount 796 would basically comprise a series 700 fuselage with new wing of same dimensions but utilizing series 810 structure to take heavier loads. Increased passenger space would be provided by deleting series 700 baggage area and installing either 53 seats four abreast to 63 seats five abreast using T34 configuration. One or two extra windows would be added to the cabin.

Powerplants would be Rolls-Royce Dart RDa. 2 506, having engine accessories re-grouped to allow one engine to be kept running and the other shut down while passengers are loaded. Extra battery capacity is also planned. Built-in folding stairway will be fitted to expedite turnaround.

Shorthaul Viscount 796 is designed for a takeoff weight of 61,500 lb., maximum landing weight of 58,500 lb. and will have a maximum payload of 11,750 lb. at maximum zero fuel weight of 50,000 lb.

Nonskeds Ask Revision Of Transatlantic Rules

Washington – Supplemental airlines are petitioning the Civil Aeronautics Board to revise its transatlantic charter policy and reduce the participation of all-cargo carriers in passenger operations.

Twenty-three supplemental carriers represented by the Independent Airlines Assn. have charged that certificated all-cargo carriers are "usurping" the transatlantic passenger charter field.

In a petition to the CAB, the association said the transportation of bona fide charter groups in international transportation must go to the scheduled passenger airlines and then to the supplemental air carriers in that order. Any other aspirants to the field, it said, should be considered only after a showing that neither the scheduled airlines nor the supplemental carriers are willing to perform the proposed service.

The petition said all-cargo carriers had applied for 220 transatlantic passenger charter flights during 1956 and the first six months of 1957.

Under the present policy, exemption authority for charter trips is granted to all classes of air carriers not holding certificates for passenger service if the necessary requirements are met. This, IAA said, results in a major portion of transatlantic charters being flown by the all-cargo certificated lines.

The group also is asking that the requirement calling for the filing of an application for exemption at least 60 days in advance of the proposed flight for pro-rata charters be reduced to 30 days for both entity and pro-rata charters.

IAA said it is impractical for either the carriers or the chartering group to compile data necessary for the submission of a formal petition to the Board as much as 60 days in advance.

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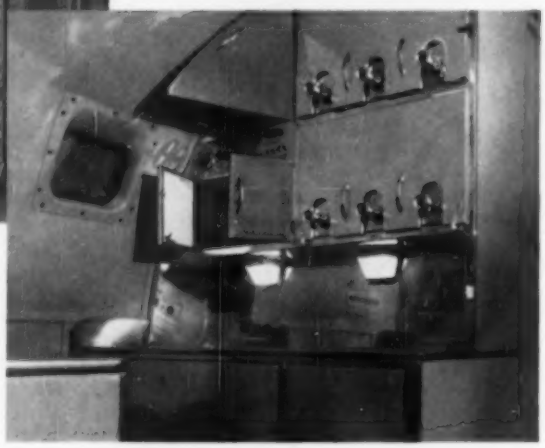
DC-6 and DC-7 LOUNGE UNITS typical of those designed, engineered, and installed by AiResearch Aviation Service for some of the world's leading airlines, including American, Pan American, Swissair, Braniff, KLM, Panagra, CPA and Japan. Berthable and curved lounges are fabricated on a production basis by highly experienced personnel.



GALLEY installation in DC-6, fabricated to customer specifications. All galley and buffet units are made of lightweight materials and can withstand loads up to 12 G's. Equipment may include electric ranges, broiler and oven units, refrigerators, dry ice storage, liquid containers and coffee makers.

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SHORTLINES

► **Hunting-Clan Air Transport, Ltd.,** a British scheduled cargo line, has appointed Seaboard & Western Airlines as its general sales agent in West Germany. Hunting-Clan operates from London to East and Central Africa via Frankfurt. Seaboard & Western also recently signed nine other interline agreements with foreign and domestic carriers.

► **Lanica,** the Nicaraguan flag airline, will purchase two Vickers Viscount turboprop transports and plans to place them in service by the end of 1957. Lanica then hopes to expand into the international field and has initial plans for scheduled service from Managua to Mexico, Panama, Quito, Ecuador and Peru. Present cargo service to Miami will be expanded to include passenger service. Lanica plans to use British crews on its new Viscounts while Nicaraguan crews are being trained.

► **Riddle Airlines** flew 42,334,773 lb. of freight through Sept. 21. This is more than the total for 1956 when the line carried 42,168,676 lb. Riddle predicts it will carry a total of more than 60 million lb. of freight this year.

► **Flying Tiger Line** reports a net income plus special items of $101,669 for the fiscal year ending June 30. This compares with $2,975,771 for the 1956 fiscal year. The airline says higher operating costs, obsolete equipment and a decline in gains from sale of equipment were responsible for the reduced earnings and special items. Flying Tiger's new fleet of Lockheed Super-H Constellations, introduced into service in May, is now adding to the airline's revenues, and earnings are expected to increase.

► **North Central Airlines** established a new daily passenger record for the company on Oct. 4 when it carried 2,739 passengers. North Central has carried over 400,000 passengers this year.

► **Iranair, Iranian Airways Co.,** has been admitted to active membership in the International Air Transport Assn. The admission brings the total of airline membership in IATA to 81–73 active members and eight associates.

► **England's Ministry of Transport** and Civil Aviation reports 1,003,152 passengers passed through British airports in July, for the first time in any month that the figure has exceeded one million. Air transport movements were reported at 44,637; freight on and off loaded was 18,034 short tons.

AIRLINE OBSERVER

► Watch for an intensely competitive battle for the lion's share of the winter transcontinental nonstop traffic between United, Trans World and American. United has been bolstered by equipment deliveries and in August passed American Airlines for the first time in many years in total passenger revenue miles flown. TWA will make its bid with increased Lockheed Model 1649 Jetstream service pitched heavily toward first class fares. American, the early leader in nonstop service, will stand pat with its DC-7 fleet until the Lockheed Electra appears in 1959.

► **Odds are increasing against any possible Trans World Airlines purchase of Bristol Britannia turboprop airliners. TWA technical delegations who recently visited Bristol's plant were unimpressed with the firm's production capacity and worried about the maintenance problems involved in the airliner and its Proteus engines.**

► Capital Airlines organizational structure has remained unchanged since David H. Baker took over the presidency three months ago (AW July 29, p. 39). Baker, former director of procurement and production for USAF's Air Materiel Command, has spent much of his time traveling over the company's system and studying its operational problems. Meanwhile, J. H. Carmichael, who was named chairman of the board at the time of Baker's election, has remained at the helm and continues to direct policy and overall operations of the carrier.

► **Passenger complaints against airport restaurant facilities are beginning to mount as the result of overcrowded conditions and poor quality of food at a number of airports. Chief targets are the temporary terminal at Idlewild, Chicago Midway and San Diego's airport restaurant which is normally crowded to capacity at meal hours with local aviation employes. Among the bright spots along the air routes are Indianapolis, Pittsburgh, Cleveland and Milwaukee.**

► World Series charter business was split between American and United Airlines. American flew the Milwaukee Braves to New York for the first two series games and then transported them back to Milwaukee in a DC-7. Yankees traveled to Milwaukee by train. United Airlines flew both teams plus newspaper, radio and television entourages back to New York for the series finale in five DC-7s.

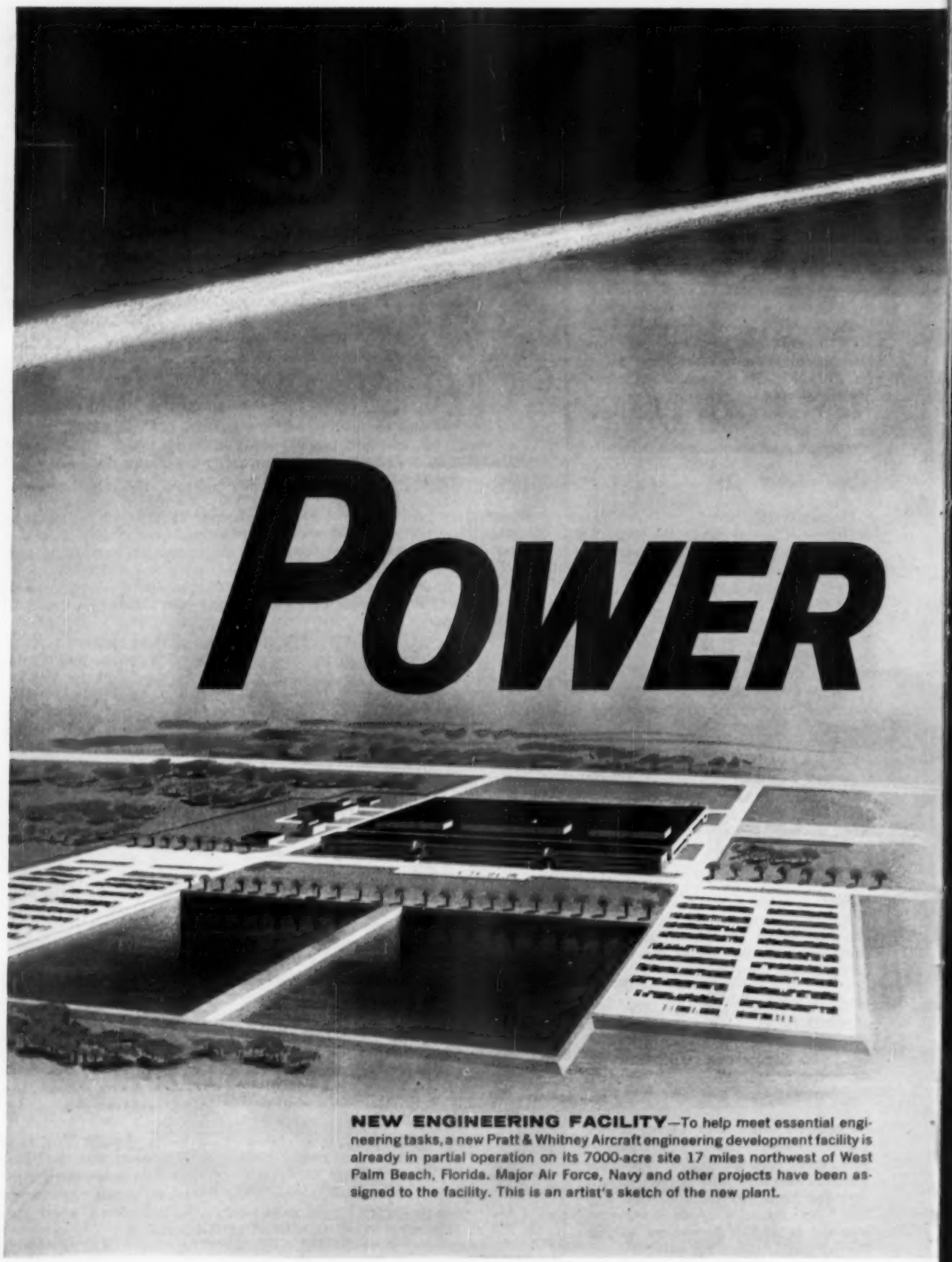
► **Heavy demand for airline limousines in New York for World Series customers forced temporary abandonment of the Carey Limousine-American Airlines special airport-to-hotel baggage delivery and pickup service. Carey didn't have enough vehicles left after supplying World Series demands to handle the business.**

► Allison is trying a conversion program for Convair 340s and 440s fitted with its 3,750 eshp. 501D-13 turboprop engines. The company will use a Convair YC-131C transport it has on bailment from the Air Force for development of this project.

► **Large increase in international irregular airline operations has caused CAA to request a change in regulations that would require air carriers, rather than the CAA, to determine the need of a navigator or radio operator as crew members on flights outside the U. S. Under the proposed ruling, radio operators will be used where radio telephone communications cannot be accomplished and navigators will be required where accurate navigation cannot be achieved from the pilot's station under normal operating conditions by means of visual or non-visual navigational aids.**

► Civil Aeronautics Administrator James T. Pyle has warned that some "bogus parts" fabricators are "counterfeiting" their products with the prime manufacturer's parts numbers in an attempt to peddle unapproved parts as the original product. Others have been known to imitate the original manufacturer's packaging for the same purpose, he said. Some bogus parts are almost impossible to detect without extensive testing.

POWER



NEW ENGINEERING FACILITY—To help meet essential engineering tasks, a new Pratt & Whitney Aircraft engineering development facility is already in partial operation on its 7000-acre site 17 miles northwest of West Palm Beach, Florida. Major Air Force, Navy and other projects have been assigned to the facility. This is an artist's sketch of the new plant.

for new aircraft...
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Few activities in aviation today exceed the significance of new developments in the power plant field.

Among these developments are the mighty J-75 turbojet, now in production for big commercial jet transports and a number of very high performance Air Force and Navy combat aircraft . . . advanced, still-secret turbine projects . . . and entirely new engines of the future.

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Dallas Air Terminal Stresses Comfort

By Craig Lewis

Dallas—City of Dallas will celebrate completion of a major part of its $25 million expansion of Love Field this month with elaborate Texas-style ceremonies.

In a week of festivities, Dallas will inaugurate its new $7.5 million terminal, a sprawling, eight-story green and red building that is the central feature in an expansion program that is virtually remaking Love Field.

The program is striking evidence, if any is needed, that Dallas intends to stick with Love Field as its permanent center for civil aviation services. Along with the terminal, a new runway and taxiway area is being added, and commercial interests are building extensive overhaul and maintenance facilities.

But the biggest thing on the program is the new terminal, and it is about ready for the airlines to make the switch from the old, cramped terminal that has served the airport since 1940. Airline service at the new terminal will begin shortly after the inaugural celebration.

ARTIST'S conception shows completed terminal, parking space, for 1,750 cars.

Convenience Emphasized

New terminal was designed for modern operation from a number of angles, but passenger convenience and comfort was obviously a prime consideration.

First indication of this design philosophy comes in the 1,750 car capacity parking lot. A 1,125 ft. covered sidewalk reaches out into the lot to protect the passenger from the elements on the way from car to terminal. Passengers can park in the lot or drive up to a door in front of their particular airline ticket counter.

Ticket area is entered through an automatic door and it's the last door the passenger encounters until he leaves the gate for his airplane. Inside the ticket lobby, he drops his luggage when he checks in. It goes directly through airline offices behind the ticket counters to a loading area on the same level, then to the proper flight.

The ticket lobby provides 360 ft. of counter space for the six passenger airlines that serve the airport. Ten feet of counter space, originally reserved by Trans American Airlines before it ceased operating, is now being held for any new airline that might serve Love Field.

Space for New Line

Provisions for extra counter space and gate space could be important, since Dallas is expected to get new, competitive service to the West Coast in the Dallas-to-the-West Case, and this could mean a new airline moving into Love Field.

Both in the ticket area and the gate fingers, airport authorities have provided for easy expansion when traffic warrants it. They figure the new terminal will easily handle the ultimate traffic capacity of the airport whenever it might be reached.

From the ticket area, the passenger moves into a spacious lobby that provides 27,750 sq. ft. of floor space, compared with 5,000 sq. ft. in the old terminal. Shops, bars, restaurants, rest areas and loading fingers all open off this central lobby area since its designers wanted the passenger to be able to stand in one place and find anything he wanted without need for exploring.

Above the lobby is a mezzanine rest area which is accessible by stairs, escalator or elevator. A passenger with time to kill can use the usual lounge facilities, or he can pay a dime to sit in theater-type seats in the upper mezzanine and have a panoramic view of the airport.

Dressing Rooms

Large rest room facilities off the main lobby include roomettes where, for 50 cents, passengers can rent a dressing room complete with tub and shower. This reflects the penchant of the terminal's designers for providing sufficient rest rooms.

They have been especially careful to build a number of them near gates in the fingers of the terminal for the convenience of passengers.

Loading passengers proceed from the lobby through a single entry into the three loading fingers. The three fingers are marked with different colors, and flight announcements will direct passengers to a gate number and color for easy identification.

Public address speakers have been placed to avoid overlapping. All airlines' routine flight announcements will

PHOTOGRAPH depicts actual state of construction of the terminal.

be taped by a professional announcer to give them a uniform tone.

At the beginning of each finger lies the only break from the designers' determination to keep all traffic flows on one level. There is a hump at this point to accommodate tunnels under the fingers. These tunnels give the airlines' ramp vehicles easy access to all parts of the ramp area.

Moving Sidewalks

The strain of climbing these humps is relieved by moving sidewalks for both enplaning and deplaning passengers that carry them between the entrance to the finger and the first gate position.

The three fingers provide gate positions for 26 transports of DC-7C size, and they can handle larger numbers of smaller transports. Present terminal has 16 gates. The terminal is air conditioned from ticket counter to loading gate. Air conditioned area includes 19 gates; center finger has seven gates for overflow traffic that are protected from weather but not air conditioned.

The fingers, along with the loading gates, rest rooms and telephones, provide considerable operational space for the airlines. Office space runs down the sides of all the fingers, broken only by short open areas to the gates. Some carriers will provide lounge facilities in the fingers, and they will use office space for flight operations, commissary and other functions.

Deplaning passengers pass through the lobby into a separate baggage wing where their luggage is unloaded from ramp trucks into a conveyor system that places it where passengers can retrieve it themselves.

Terminal building was designed to facilitate maintenance work and to keep it out of sight. Catwalks in an attic over the lobby area and an elaborate system of tunnels under the terminal will allow crews to do most housekeeping out of sight. Cleaning problems have been eased by widespread use of terrazzo and tile.

Utility tunnels extend the full length of each finger, and they are big enough to admit a pickup truck. A smaller tunnel runs from the end of one finger tunnel to the edge of the instrument runway for servicing of Love Field's new precision approach radar.

Control tower in the new building is eight stories high. Top four stories will be occupied by Civil Aeronautics Administration and Weather Bureau facilities. The CAA tower will not move from the old terminal until spring in order to avoid disturbing radar and traffic control systems during the winter's poor weather.

American, Delta, Braniff and Continental financed a $1 million underground refueling system that carries fuel directly from storage tanks to each of the 26 gates. Ultimate delivery capacity is 25,000 gal. per min. Current storage capacity is 600,000 gal., and this will eventually be expanded to 1.5 million gal. System will be operated by Allied Aviation Fueling Company of Dallas.

Runway Expansion

Along with the new terminal, Dallas is spending $5 million to expand runways, taxiways and other ground facilities. Instrument runway (NW/SE) is currently 7,750 ft. long, and the N/S runway is being lengthened to 6,000 ft. New taxiways and ramp area have been laid to service the new terminal and altered runway system.

Dallas quotes CAA reports to prove that Love Field is ready to handle turbine transport operations. Applying correction factors, the effective length of the instrument runway is 6,352 ft., and Dallas authorities say this will be plenty for a transport of the Boeing 707 type since the most distant point a jet is liable to serve is Seattle, about 1,700 mi. away.

If more length is necessary, the instrument runway can be extended to 8,500 ft. within present airport boundaries. When traffic warrants it, probably in 3-5 years, a second instrument runway will be installed parallel to the

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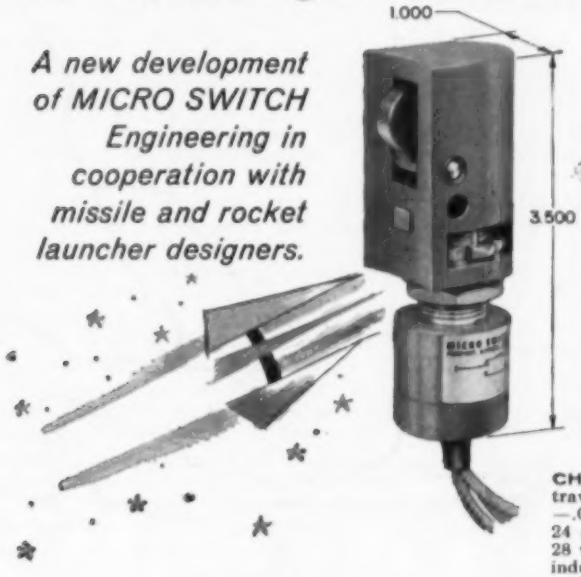
A new development of MICRO SWITCH Engineering in cooperation with missile and rocket launcher designers.

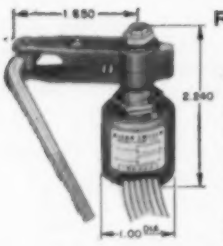


This MICRO SWITCH Type 21AS2 "Rocket Switch" is designed for use on missile and rocket launchers. It may be used anywhere a rugged, sealed, small switch is required for an indicating or lockout device.

The assembly is environment-proof and successfully resists corrosive propulsion gases and normal adverse conditions found in exposed locations of high speed aircraft.

The assembly uses one SPDT EN switch attached to a rugged cam type actuator. It is small and compact and can be located in extremely limited space. The 1EN33 switch used conforms to MS24331-1.

CHARACTERISTICS—Operating force—6-12 lbs. Full overtravel force—10 lbs. min. Release force—4 lbs. min. Break distance—.010 in. min. Electrical data: 28 vdc rating at sea level: inrush 24 amps., resistive 4 amps., inductive 3 amps., motor 4 amps. 28 vdc rating at 100,000 feet: inrush 24 amps., resistive 4 amps., inductive 2 amps., motor 4 amps. (Altitude ratings established with seal deliberately broken.)



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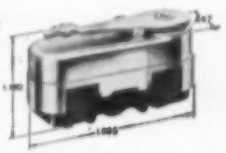
MICRO SWITCH EN Series Switches are small, lightweight, environment proof and easily mounted in difficult locations. They are available with a wide variety of actuators and mechanical and electrical characteristics.

The MICRO SWITCH Type 41EN1-6 (shown) is a rotary-actuated, positive drive switch for linkage-type actuation. Because there is no return spring the driving mechanism must control shaft movement. This positive drive insures actuation and release under the most adverse environmental conditions of ice and dirt.

CHARACTERISTICS

Differential travel—12° max. Free position—35°. Weight—2¼ oz. Electrical data: 28 vdc rating at sea level: inrush 24 amps., inductive 3 amps., resistive 4 amps., motor 4 amps. 28 vdc rating at 100,000 feet: inrush 24 amps., inductive 2 amps., resistive 4 amps., motor 4 amps. (Altitude ratings established with seal deliberately broken.)

MICRO SWITCH HS switch has a true hermetic seal to insure constant reliability



MICRO SWITCH HS Series of precision switches is designed for aircraft applications where constant operating conditions must be maintained regardless of changes in atmospheric conditions.

The switching element is sealed in a gas-filled chamber. This has been evacuated and filled with dry inert gas under pressure. Conductors from the switching chamber to the terminals are sealed in glass. The switch is operated by a "wobble fram" actuator. The switch shown (type 1HS1) is qualified as MS25011-1. HS switches are also available with roller lever and leaf actuators.

CHARACTERISTICS

Operating force—10-22 oz. Release force—4 oz. min. Overtravel—.010 in. min. Differential travel—.020 in. max. Weight—1.5 oz. Electrical data: 28 vdc rating: inductive 10 amps., resistive 25 amps. 125 vac rating: inductive 1 amp., resistive 1 amp.

For complete information on MICRO SWITCH precision switches for aircraft send for Catalogs 77 and 78.

MICRO SWITCH Engineering Service, with a background of two decades of cooperation with aircraft designers, is as close as your nearest MICRO SWITCH branch office

MICRO SWITCH

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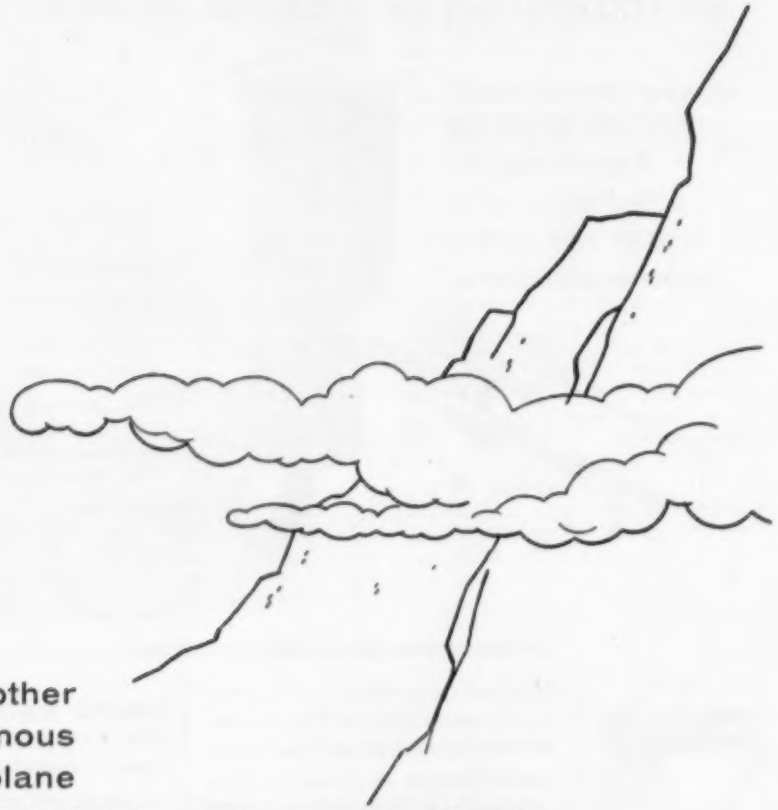

Another famous plane

PROVEN IN SERVICE

Twenty-two years ago the DC-1's transcontinental time of 11 hours and five minutes was headline news — today it is but another memory of the "Good Old Days" of aviation. But even in 1935 Rockbestos wire and cable had earned a proven-in-service reputation.

Today, Rockbestos can look back on 39 years of developing and manufacturing quality wire and cable, and a long history of close association with the aviation industry.

Rockbestos has continually produced high temperature wire which meets the exacting standards of modern airplanes . . . both military and commercial.

Rockbestos will continue to develop wires to meet the aircraft industry's needs. Find out just how Rockbestos can help solve your high temperature wiring problems. Write, wire or phone for complete specifications and application information.

1935

Douglas DC-1, forerunner of famous DC commercial planes, sets transcontinental record of 11 hrs., 5 min. — Los Angeles to New York

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present runway, but 3,000 ft. away on the opposite side of the terminal. Dallas owns most of the land now for the second runway, and until it is needed the property brings in about $400,000 a year in rentals.

Construction of the new terminal caused considerable dislocation of commercial facilities at Love Field. Braniff's old headquarters building had to come down, and the company has moved its general offices to the new Braniff Building in nearby Exchange Park. Southwest Airmotive's service facilities were on the terminal site, so the company moved across the field to a new site.

Braniff Base

Braniff's present maintenance base is adjacent to the new terminal, but it will move across the field when the new Braniff base is finished next year. When the old base is razed, more airfreight facilities will be built to supplement already oversubscribed space in the new cargo terminal.

Completion of Love Field's new facilities furnishes emphatic evidence that Dallas intends to stick with its present airport and maintain it as a modern airline traffic hub. And it is convincing proof that the question of sharing a midway airport with neighboring Ft. Worth is completely dead.

Dallas and Ft. Worth have squabbled bitterly in the past over the airport issue. Ft. Worth has argued that the two cities should share Amon Carter Field, built midway between them, because it is safer and would be more economical than supporting two first class terminals. Dallas retorted that it wouldn't have its citizens go half-way to Ft. Worth for airline service when it already had an airport only five miles from downtown.

City Rivalry

The argument has simmered down in the past few years as relations between the two cities have been gradually improving. Now the issue is mainly confined to Ft. Worth's complaints that the airlines don't furnish adequate service at Carter Field and Dallas' contentions in CAB cases that American favors Ft. Worth in its scheduling.

Dallas cites convenience as a major element in its decision to develop Love Field. The new terminal is a little over five miles from downtown Dallas. Since about 75% of the air travel out of Dallas is business travel, time and convenience are important considerations. Love Field is also convenient to the north Dallas residential areas where the majority of its businessmen live.

Answering objections to the safety margin in an airport in the midst of a heavily settled area, a Dallas official says the city feels that any successful airport will attract development to its

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- ☐ Nickel Plating (AMS-2403)
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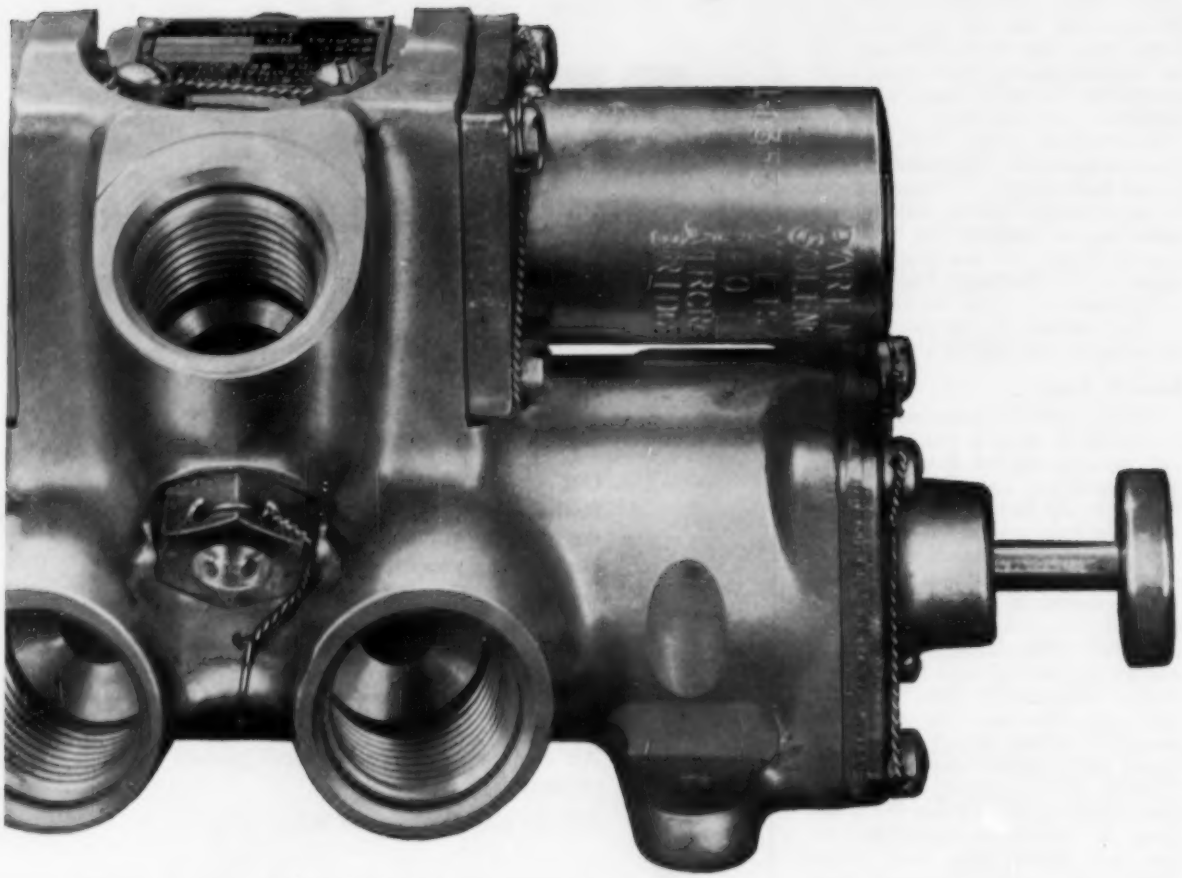

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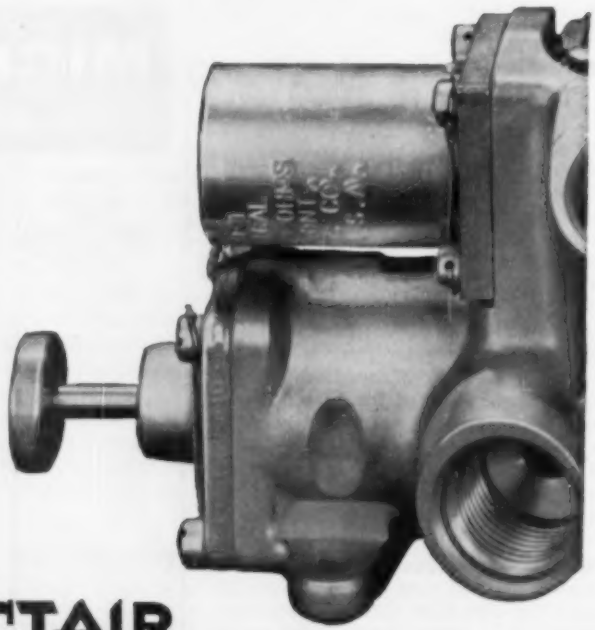
Translating valve requirements from design, through precise volume production, to uniform operating performance is our business. Many air frame designers now know us. All should.

Case in point: this 4-way solenoid-operated hydraulic selector valve with manual override. TACTAIR engineering combines in this valve the weight-saving features of a pilot-operated unit with a pressure-balanced main valve.

Results: a light, compact unit requiring low current drain; maximum efficiency; precision reproduction in volume.

Reminder: on standard or special design, we will welcome a call on your next precision valve problem. Our service is as *personalized* as this message. TACTAIR Valve Division, Aircraft Products Company, Bridgeport, Pa. BRoadway 5-1000.



CONTROL, SELECT, BRAKE, RESTRICT, CHECK...with **TACTAIR**

area, so there would be no permanent benefit in moving.

Current development of Love Field follows the basic lines laid down in a master plan adopted in 1945. Financing for the projects has come from a series of bond issues. The $7.5 million terminal was paid for with general obligation bonds, and $5 million worth of ramp, taxiway and runway work was financed by revenue bonds which obligate airport revenues.

To help commercial expansion, Dallas financed construction with $10.5 million of revenue bonds tied to income from long-term leases. Southwest Airmotive got $1.5 million to help build its new service base. Southwest Airmotive is also leasing the old terminal building.

Dallas also allotted $6.5 million in bond financing for the new Braniff maintenance base, $1.2 million for Delta's base and $1.3 million for American's new facility.

Financial Status

Love Field has been in the black on an operating basis since 1943, and income covered debt service also in the 1952-54 period. As more bonds were sold, debt service exceeded operating profits, and it will be several years before income will cover debt requirements again. For the fiscal year ending September 30, 1958, income is estimated at $1,909,308 and operating expenses at $1,280,107.

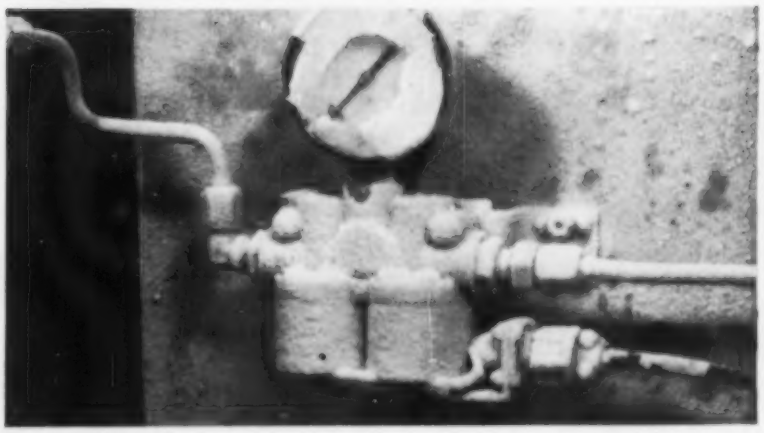
Week-long inaugural festivities will begin with an open house for employes October 20 and last through an open house for the public October 26-27. Ceremonies will include a dinner honoring business and civic leaders, a pioneer day and a national press preview.

Highlight of the celebration will be a speech by Civil Aeronautics Board Chairman James R. Durfee at a luncheon for airline presidents and a subsequent speech by Civil Aeronautics Administrator James T. Pyle at formal dedication ceremonies.

CAB Awards Routes in Phoenix Decision

Washington—New and improved air service from Phoenix to Denver, Salt Lake City, San Diego and Los Angeles via Palm Springs has been approved by the Civil Aeronautics Board. The service will be provided by Bonanza, Frontier and Western Airlines. In the Service to Phoenix case, the CAB decided that:

• **Western Air Lines** is authorized to provide service over a new segment between the terminal point Denver, the intermediate point Phoenix and the terminal point San Diego, subject to



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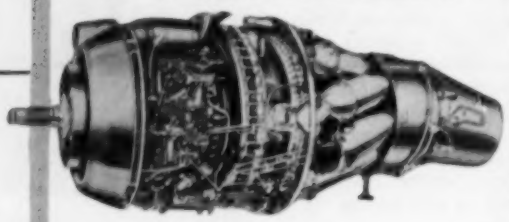

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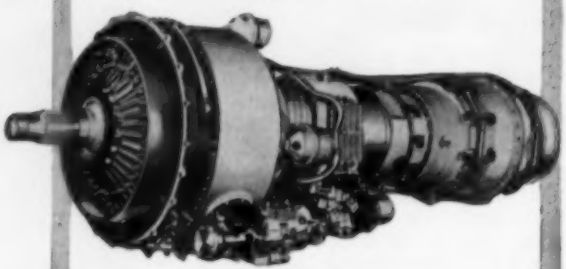
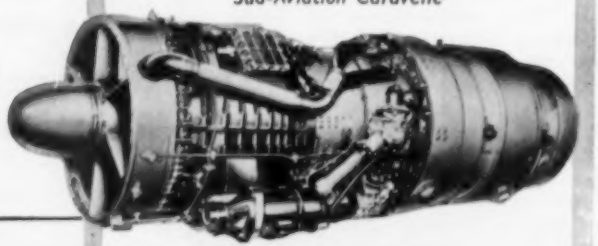
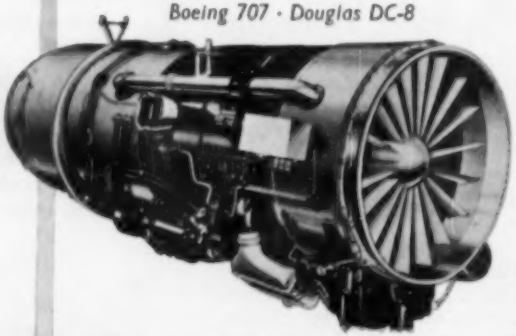


AVON
TURBO JET
de Havilland Comet
Sud-Aviation Caravelle



CONWAY
BY-PASS TURBO JET
Boeing 707 · Douglas DC-8



Rolls-Royce have over 3,000,000 hours experience in the operation of gas turbine engines in scheduled airline service.

ROLLS-ROYCE LIMITED, DERBY, ENGLAND.

the condition that all flights serving Denver and San Diego shall also serve Phoenix.

• **Bonanza Air Lines** is to provide service over a new segment between Phoenix and Salt Lake City via intermediate points at Prescott and Grand Canyon, Ariz., and Provo, Utah, for a period of three years, with authority to provide nonstop service between the terminals.

• **Palm Springs, Calif.**, will be added as a joint intermediate point with Indio, Calif. on Bonanza's route between Phoenix and Los Angeles. Bonanza will be permitted to overfly Blythe, Calif., on that route so long as Blythe is scheduled to receive at least two daily round trips.

• **Present restriction** on service between Phoenix and Denver is modified to authorize Frontier to provide a two-stop service between Phoenix and Denver on two segments and to overfly Farmington, N. M., the junction point, so long as all points on segments two and four are scheduled to receive at least two daily round trips.

CAB also decided to reopen record for the limited purpose of receiving evidence as to whether it should order the amendment of Bonanza's certificate to provide for any or all of the following:

• **Designation of St. George, Utah**, as an intermediate point on the Phoenix-Salt Lake City route.

• **Designation of Kanab, Utah**, as a joint intermediate point with St. George on that route.

• **Designation of Kanab** as a separate intermediate point.

• **Designation of Kanab** as an intermediate point in lieu of St. George.

In its order, CAB denied applications by Western and Frontier to provide Phoenix-Salt Lake City service and applications by United, Continental, Frontier and Trans World airlines for Denver-Phoenix authority.

AMB to Survey Sites For New D.C. Airport

Washington—Greiner-Mattern & Associates of Baltimore and Roanoke received an Airways Modernization Board contract to conduct a survey of possible sites for a second airport in the Washington area. The award was announced by Gen. Elwood Quesada, special presidential assistant for aviation facilities planning and chairman of the AMB.

A report will be made by the firm on the technical, engineering and economic factors involved in all possible sites. In addition, the firm will be responsible for the direction of a survey to forecast aviation needs for the Washington area up to 1975. This will include a forecast of passengers, freight and general aviation volume, various

MICRO-BEARING ABSTRACTS

by **A. N. DANIELS**, *President*
New Hampshire Ball Bearings, Inc.

DYNAMIC AND STATIC LOAD RATINGS

Load ratings of MICRO bearings are based on standards established by the Anti-Friction Bearing Manufacturers Association and are the result of extensive tests.

The "life" of an individual bearing is defined as the number of revolutions the bearing makes before the first evidence of fatigue develops. Fatigue, in turn, is a function of bearing load and although other factors, such as contamination and high temperature, affect the life of a bearing, it is assumed that clean bearings running at normal temperatures are being considered.

It is not possible to predict the life of any individual bearing. The problem, therefore, is best approached by a consideration of empirically derived dispersion curves which provide a means of determining bearing life on a probability basis. That is, they permit the average life of a given group of bearings to be accurately specified.

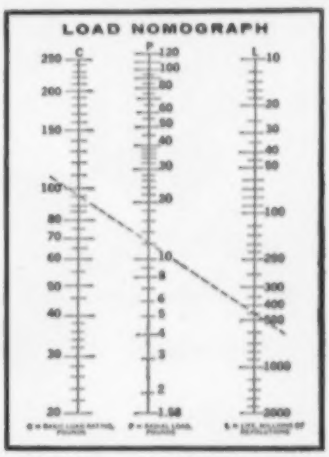
For purposes of standardization, the "rating life" of a group of apparently identical ball bearings is defined as the number of revolutions that 90% of the group will complete or exceed before the first evidence of fatigue develops. This figure is approximately one-fifth of the average life.

If two groups of similar bearings are run under different loads F_1 and F_2 within normal operating range of loading and rpm, their lives L_1 and L_2 are inversely proportional to the cubes of the loads, i.e., The BASIC LOAD RATING C is that radial load which a group of apparently identical bearings can endure for a rating life of one million revolutions, with stationary load and rotating inner ring. Within normal operating ranges, rating life for any load is a constant number of revolutions, so the following relationship, a restatement of the inverse cube proportion, may be used to compute rating life when basic load rating and applied radial load are known:

$$L = \left(\frac{C}{P}\right)^3$$

L = rating life in millions of revolutions
where, C = basic load rating in pounds
P = applied radial load in pounds

The nomograph illustrated permits the quick evaluation of any one of the three quantities when the other two are known. For example, if the C rating of a given bearing is 95 pounds, and the bearing is loaded radially with



12 pounds, P, a straight edge crossing these two values in their respective columns shows that the bearing could be expected to have a life, L, of 450 million revolutions.

"EQUIVALENT LOAD"

Bearings whose loads are primarily radial are usually also subjected to axial forces. When the axial component of the load is greater than a negligible value, this combined radial and thrust load may be expressed in terms of a simple radial load in order that the basic load rating C may be calculated. This simple radial load is known as the "equivalent load", which is that constant stationary radial load which, if applied to a rotating inner ring, would give the same life as that which the bearing will attain under the actual conditions of load and rotation.

A formula for determining "equivalent load" and a more comprehensive discussion of static and dynamic loads is found in our design handbook.

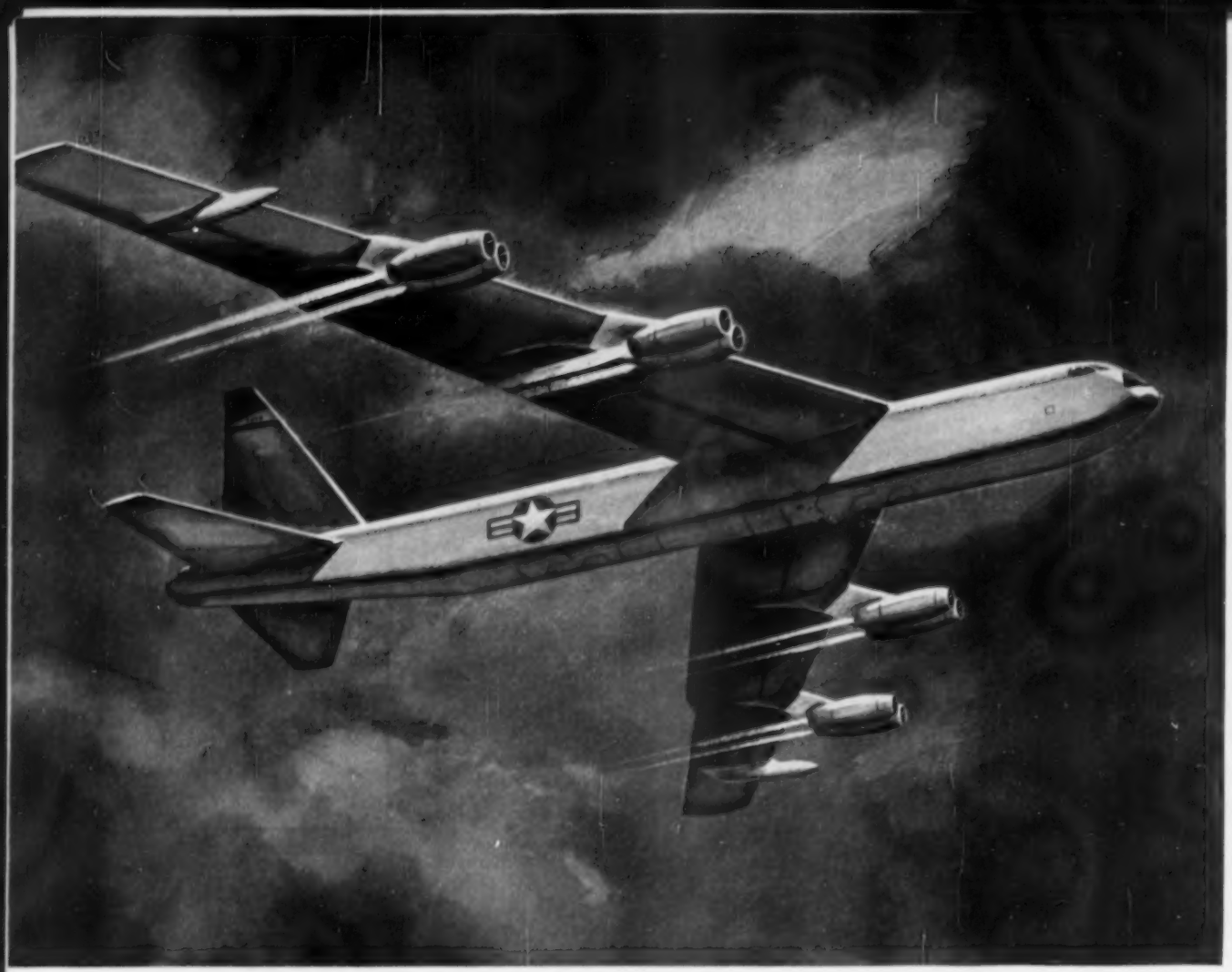
DESIGN HANDBOOK OFFERED *FREE*

You'll find this new, 70-page authoritative publication a great help in solving problems in designing instruments or small electro-mechanical assemblies.

Write to: New Hampshire Ball Bearings, Inc., Peterborough 1, N.H.

Typical cut-away views of instrument-type retainer ball bearings.

NEW HAMPSHIRE BALL BEARINGS, INC., PETERBOROUGH 1, NEW HAMPSHIRE



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SAC expresses America's desire for peace with honor and justice. For SAC's far-ranging aircraft, RCA provides the priceless asset of complete and instantaneous communication.

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types of civil and military aircraft to be operated and airspace and traffic control requirements needed to handle the expected traffic safely. In this connection, the firm will use Landrum & Brown, Cincinnati, Ohio; Aeronautical Research Foundation, Cambridge, Mass.; Airborne Instruments Laboratory, Mineola, N. Y., and Cornell Aeronautical Laboratory, Buffalo, N. Y.

During its last session, Congress appropriated $12.5 million to begin construction of a second airport in the Washington area.

No funds from this appropriation can be spent, however, until the President reports to Congress upon the selection of a site. The report is due in Congress by Jan. 15. Quesada's report will go to the President by Jan. 1.

Quesada said that, after all possible sites have been reduced to the best two or three, public hearings in each community involved will be held to determine the impact the airport would have on the community.

North Central Given New Midwest Routes

Washington—North Central Airlines has been authorized new service between Duluth-Superior and Sault Ste. Marie and nonstop service between Duluth and Chicago by the Civil Aeronautics Board.

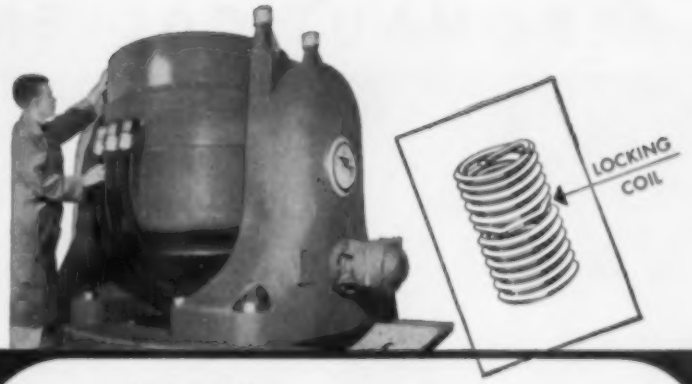
At the same time, the Board withdrew Northwest Airlines' authority to serve Duluth-Superior, Green Bay, Wausau, Eau Claire and La Crosse. Northwest has not served these points for the last several years.

In its final decision in the Duluth-Chicago Service Investigation, CAB found a need for improved Duluth-Chicago service but said there was no need for the services of both North Central and Northwest. CAB also said North Central now provides substantial frequency of service at the other Wisconsin cities, which Northwest does not seek to serve, and that there is no need to continue authorizations at these points.

Because of the isolation and serious lack of east-west transportation facilities in the Upper Peninsula of Michigan, the CAB decided to certificate North Central for this service for a period of three years. Ironwood, Hancock-Houghton and Marquette will be served on this route.

North Central also was authorized to provide one-stop service between Duluth and Chicago via Madison and two-stop service between the two points via Milwaukee and Green Bay.

Northwest had asked to reactivate its service from the Twin Cities to Duluth or inaugurate an interchange service with North Central.



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USES *HELI-COIL SCREW-LOCK INSERTS**
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Currently the world's highest force electro-dynamic vibration exciter, the MB Model C250, made by the MB Manufacturing Co., is vital to government research in today's air age... has a frequency range of 2-500 cps., and a total force output of 25,000 lbs. It can be adapted to operate in chambers where temperatures range from −100°F to 300°F and simulated altitudes hit 125,000 feet.

Test specimens of up to 2190 lbs., subjected to accelerations of 10 g., must be securely held to the unit's moving assembly.

The thread assemblies within the vibrator, and joining test specimens to the unit, are subjected to grueling shock and vibration. Yet, even under these extreme conditions, *Heli-Coil* Screw-LOCK Inserts (277 of them) function perfectly... protect threads against stripping... hold fasteners securely.

Meeting military specifications for torque and vibration, this new, one-piece stainless steel Screw-LOCK Insert:

1. positively locks screws against loosening under impact and vibration
2. prevents thread wear, stripping, corrosion, galling, seizing
3. eliminates the need for lock-nuts, lock-wiring, and other supplementary locking devices
4. offers high re-usability on repeated disassembly and reassembly.

Heli-Coil Screw-LOCK Inserts are available in many sizes, including the new miniature 4-40. For further information, write

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LITTON'S Hansen, Le Vantine and Stephenson (left to right) are grouped around inflated suit in high-vacuum chamber.

Laboratory Simulates 95-Mi. Altitude

By Irving Stone

Beverly Hills, Calif.—Unique inhabited high-vacuum laboratory was unveiled here by Litton Industries, designer of the research tool, with the announcement that the vacuum chamber with an experimenter inside had been able to simulate 95-mi.-altitude pressure conditions.

Existence of the laboratory originally was revealed in AVIATION WEEK (Oct. 22, 1956, p. 31), which also revealed a previous record run to 90 mi. altitude (Aug. 12, p. 26).

Sponsored by AFOSR

A fundamental tool for gathering research data for ultra-high-altitude systems by direct man-controlled experiments within the chamber, the facility and associated program is sponsored by Air Force Office of Scientific Research, Commanded by Brig. Gen. H. F. Gregory, and monitored by OSR's Directorate of Advanced Studies, headed by Dr. Morton Alperin.

Laboratory will be used to advance knowledge on physical phenomena and behavior of equipment and instrumentation under low pressure environment encountered in space.

High altitude areas which can be explored include:

- **Action of lubricants** in ionospheric environments, where common lubes are known to vaporize.
- **Operation of sliding** contacts and other mechanisms, where friction phenomena is altered by absence of air-layer on surfaces.
- **Reaction of materials,** components, protective equipment to X-rays and ultraviolet rays beamed through chamber portholes.
- **Electron tube behavior,** without necessity for using new tube model for each alteration of experiment parameters, thus saving valuable time by direct manipulation of unshielded test articles in the evacuated chamber.

SIEGFRIED HANSEN, Litton's technical director of research, models suit.

In addition to these example applications the facility can be applied to a broad field of development where vacuum conditions are part of the basic research. It will allow a scientist to be brought directly into the environment where he becomes part of the equipment.

Chamber Advantages

His observations can be translated into direct alterations of test equipment rather than depending on remote control, which is eliminated. It will allow him to immediately pursue phenomena and get first-hand data on successive changes. Big economic advantage is found where the experiment is not repetitive and involves extensive cost to set up initially.

Estimate of average cost for running an inhabited chamber test is $125 per hour.

During demonstration of the high-vacuum chamber, the trial started at an initial altitude of 87 mi. But this height had to be reduced because of slight damage to the outer-layer covering on the special Litton-designed suit which the subject wears. Subject demonstrated that he had good visibility, good dexterity of fingers and mobility of arms. Litton claims it is the

only garment which exists today which affords this degree of mobility under these experimental conditions.

Aluminum components, used mainly in the upper part of the garment, are included to minimize leakage.

Garment Construction

Basic garment is made of rubberized nylon, weighs about 50 lb., and includes a standard USAF ventilating suit. This rubberized nylon unit is subject to some gas leakage and volatilization and is covered by a rubber outer layer to prevent these effects from being transmitted to the chamber atmosphere. Oxygen lines to the suit are also covered by a similar rubber shroud for the same reason. This rubber shroud material has not been used for the suit proper because it is not as strong as the rubberized nylon. It is cheaper to replace a shroud than it is to build a suit of this material and replace it as it deteriorates.

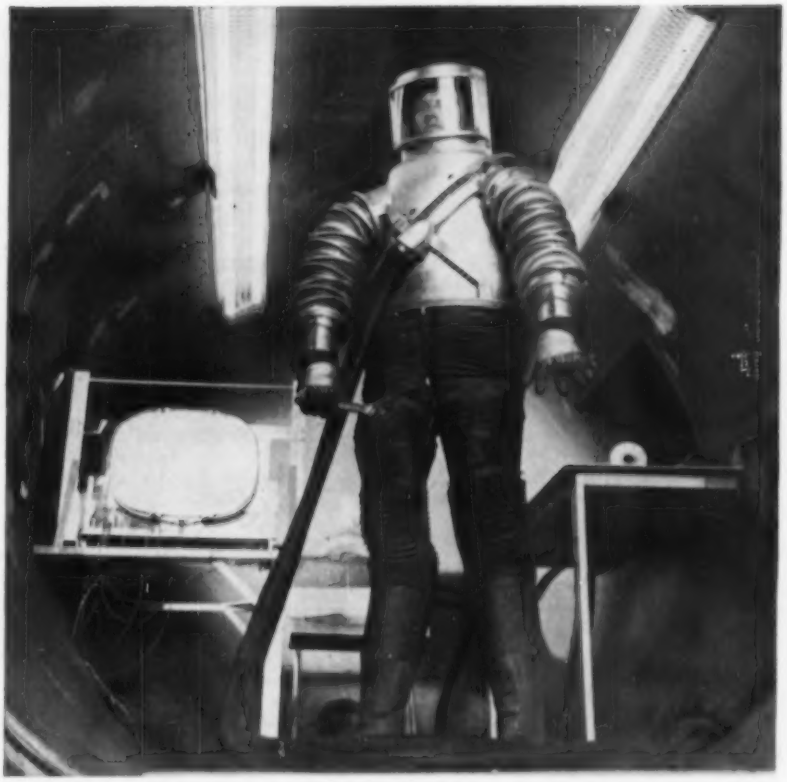
Suit is designed to allow breathing and removal of body heat. Both these functions use oxygen and are accommodated by using a single system rather than using a system for each, which would involve a difficult problem of insulation. Oxygen used for breathing is very little in comparison with that used to remove heat. After heat removal cycle, the oxygen is reclaimed for economy.

No Emergency to Date

Time found to be desirable to bring chamber and subject down to sea level is 30 sec. This has been tried many times and found to be satisfactory. No operation to date has required any emergency letdown procedure.

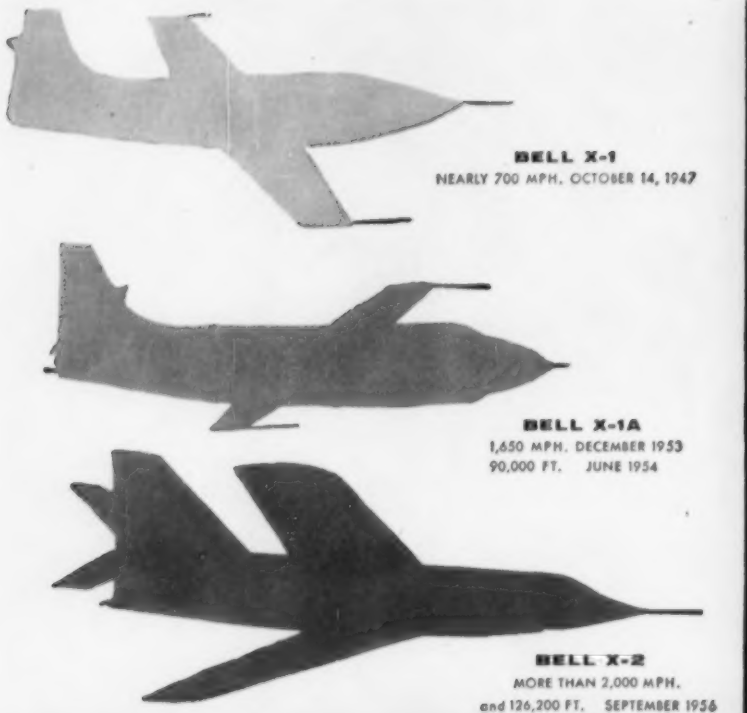
Oxygen is piped into the suit at 5 psi. absolute. This brings the subject to an approximate altitude of 27,000 ft., but instead of air he is breathing pure oxygen. Subject can stay at this altitude for various lengths of time depending on the type of work he performs.

AVIATION WEEK has learned that during the 95-mi. record chamber run, the subject, Siegfried Hansen, Litton's technical director of research, was at this altitude for approximately 3½ hr. Other Litton staff members who have participated in chamber runs include Allan De Vantine (who was in charge of suit design), Niels Jensen and Richard Assaley. In the chamber, the subject can use hand tools such as screwdrivers, pliers, etc., power tools such as a drill and perform inert gas welding. He can pick up a relatively large electron gun which can be used as an appreciable source of energy. It can be used in friction experiments to blast away surface (friction) gases, and can also be used, with its ionization action, to detect small leaks in the chamber

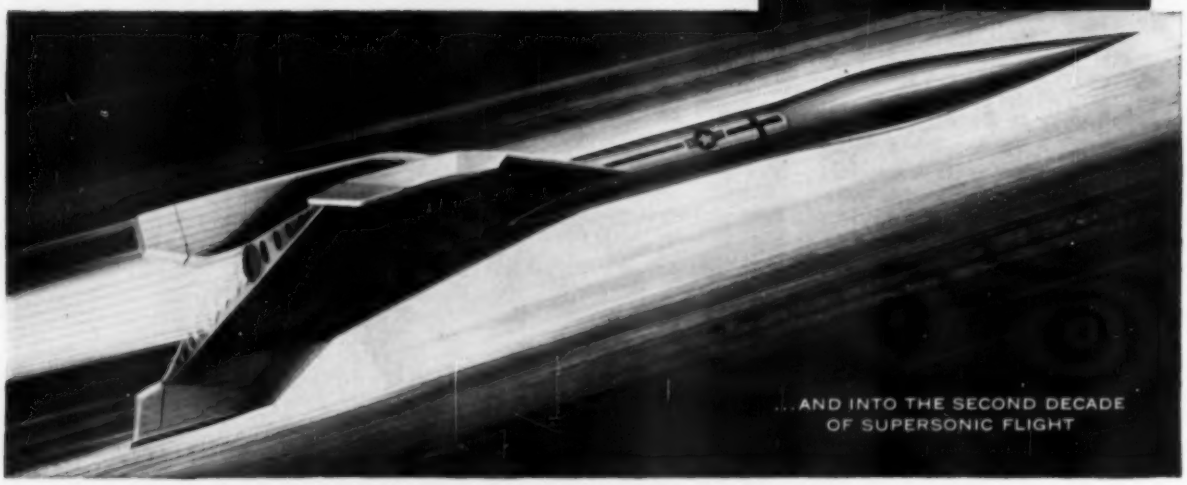


ALUMINUM upper part of Litton suit is fed oxygen through umbilical hose. Rubber shroud has been removed from suit to expose rubberized nylon portion. Shell of color chromatron tube at left can be split for access; it operates in vacuum. Suit permits scientist to enter chamber to adjust research equipment.

SUBJECT manipulates screw driver on equipment in chamber. Slack cable attached to overhead trolley rail supports him if he falls for any reason. Safety measure is designed to avoid smashing of face plate. Suit circumvents remote control.



10 YEARS BEYOND THE SONIC BARRIER



Aviation history was made on October 14, 1947 when the Bell X-1 reached a speed of nearly 700 mph. Man had broken the sound barrier for the first time!

The rocket-powered X-1 thus opened the door to a decade of significant advances in high-speed, high-altitude flight. A few years later the Bell X-1A, successor to the X-1, set a new speed record of 1,650 mph and a new altitude record of 90,000 feet.

Then, still working in conjunction with the U. S. Air Force and the National Advisory Committee for Aeronautics, Bell produced the X-2 which reached more than 2,000 mph and 126,200 feet...the fastest and highest that man has ever flown.

Never intended for tactical operation, these experimental aircraft made invaluable contributions to aerodynamic design and the art of supersonic flight. They left their marks on the airplanes of today and tomorrow and blazed the trail to the supersonic age.

Today, ten years after the first flight beyond the sonic barrier, the team of Bell engineers responsible for the famous series of X-airplanes, is working on even more advanced aeronautical concepts. One of the more challenging of these is an aircraft which will combine the ability to take off and land vertically with the high speed and performance of a conventional jet.

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Aircraft Division
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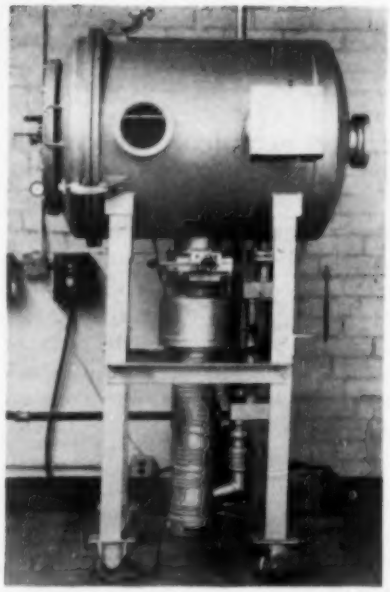

SMALL test chamber was used to check out suit and chamber parts before design froze.

or in pressure-sealed devices used in chamber experiments.

Facilitates Movement

The suit is designed to avoid change of volume as the subject moves. This makes him reasonably free to manipulate objects, with only the burden of moving the suit joints. Suit is raised off subject's shoulders to lessen fatigue.

A slack cable is attached to the suit from an overhead track as an emergency precaution to prevent the subject from falling from any cause and smashing the suit's ¼-in. Plexiglas faceplate.

Uninhabited, the chamber has been

Chamber Contract

Original AFOSR-Litton contract covered feasibility study for inhabited high vacuum laboratory. This was extended to include fabrication of the facility, research, development and testing. Total cost of bringing this facility to operational status has been about $600,000. This contract has now been completed and Litton is not under AFOSR contract at this time. It is anticipated that AFOSR will award Litton contracts for various research programs which probably will be in the field of physical research and are not expected to encompass aeromedical research normally accomplished under direction of other agencies.

Litton also is anticipating entering into contracts with other agencies and companies covering various phases of high vacuum studies. Such contracts will require AFOSR approval for use of the government-owned facility.

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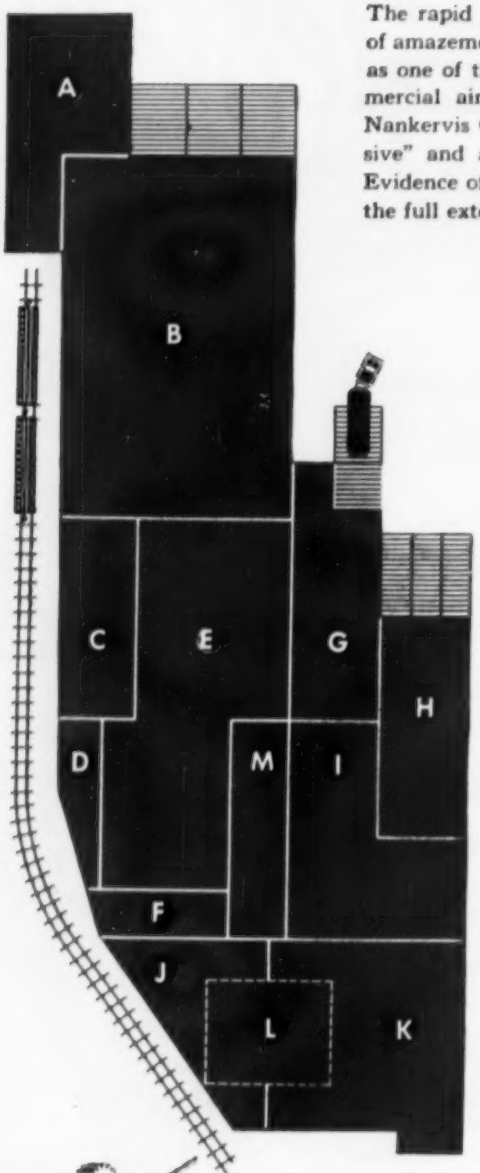

The rapid growth of the George L. Nankervis Company has been a source of amazement to the aircraft industry. Today the Nankervis Company is rated as one of the prime producers of test equipment for both military and commercial aircraft operators. Although not the oldest in the industry, the Nankervis Company has chalked up a record for being "young and progressive" and as having the "finest facilities and personnel in the business." Evidence of this growth and acceptance is the facility layout at left, showing the full extent and integration of the Nankervis test equipment headquarters.

A CALIBRATION AREA — Brand new, handles interchangeably, six different types of fuels and oils at temperatures ranging from — 100° to 360°F. Capacities up to 500,000 pph. Accuracy to 1/10 of 1%. Calibration facilities available for customer's use.

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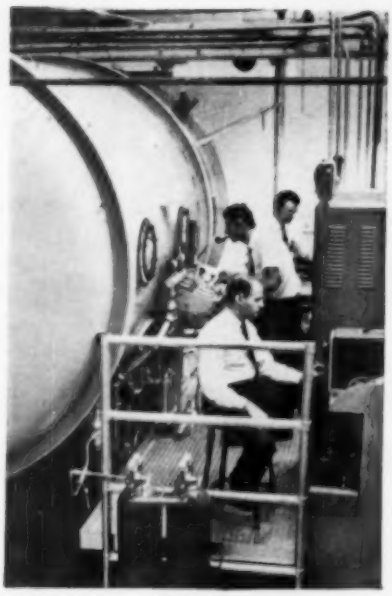

DOCTOR in foreground monitors instruments showing respiration, pulse of suit wearer.

taken to an altitude of 140 mi. Improvements already made may permit it to be evacuated to correspond to an altitude of about 160 mi.

Vacuum chamber proper is 8 ft. in diameter and 15 ft. between end bells. Volume is approximately 700 cu. ft. Wall is ½-in. hot-rolled steel plate. Portholes on the side permit viewing by outside observers.

Pumping Requirements

Two pumping systems are required to obtain the very low pressures. A roughing pump is used to bring pressure initially to somewhere between 0.1 to 1 mm. hg. Beyond this point a 32-in. diameter oil diffusion pump is used.

Perforated plate on floor of chamber is tied to an emergency let-down system.

Litton is not concerned with aeromedical aspects of high altitude environment but it does have flight surgeons monitor closely all runs made with the chamber. These medical men include Dr. John R. Poppen, Capt., Medical Corps, USN (Ret.), and Drs. Francis Quinn and Bruce Leamer of University of California, Los Angeles, Medical Center. Dr. Leamer was in attendance during the public demonstration run. Sufficient data is obtained to determine that the subject in the chamber is in safe condition. Instruments at an outside station record such factors as heart action, blood pressure, respiration, etc.

In addition to medical observation, another outside station is manned by a systems controller who, in addition to having visual access to the chamber through a porthole, can check carbon dioxide, temperature buildup, oxygen flow rate, etc. A pumping controller mans a third station.

Administrative director of the Litton inhabited high vacuum laboratory is Albert Stephenson.

Light Lithium Alloy Still Strong at 400F

Use of lithium in aluminum has produced a new aluminum alloy which maintains high strength up to 400F, according to a recent announcement of Alcoa, Pittsburgh, Pa. New X2020 lithium-aluminum alloy will raise the Mach number level for aluminum from Mach 2.0 to Mach 2.5.

Alcoa said that its extensive research with lithium indicated that the rare earth element not only serves to maintain aluminum's strength at high temperatures, but also produces an unusual increase of the modulus of elasticity.

Because lithium is so light (it will float on water) the resulting X2020 alloy is more than 3% lighter than previous aluminum aircraft alloys. Though there were many obstacles to melting and casting a sound ingot, Alcoa said that all mill products of this alloy lend themselves to standard fabrication.

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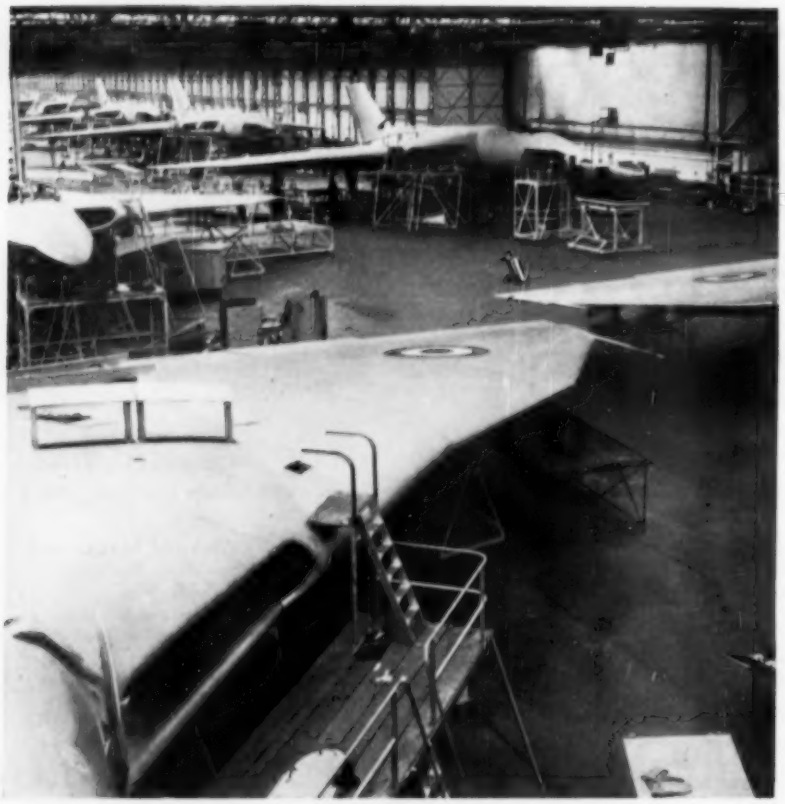
VULCAN wing tanks are fueled from pressure fittings in wheel wells. System includes five outboard, two root wing tanks on each side.

Vulcan, Going to Squadron, Escapes Usual



VULCANS move down the Avro production line. Kinked leading edge of the wing, a modification somewhat like NACA's conical camber, shows clearly on plane in foreground.

Waddington, England—RAF's first operational squadron equipped with the delta-winged Avro Vulcan has completed its conversion here.

Crews of No. 83 Squadron, Bomber Command, have taken over the big white deltas from instructors of No. 23 Operational Conversion Unit. Three weeks before the squadron completed its training, it won four out of the six trophies in Bomber Command's 1957 bombing and navigation competition.

Three crews selected from both units now on this station will compete against USAF Strategic Air Command crews in bombing, navigation and reconnaissance trials Oct. 30 to Nov. 5 at Pinecastle, Florida.

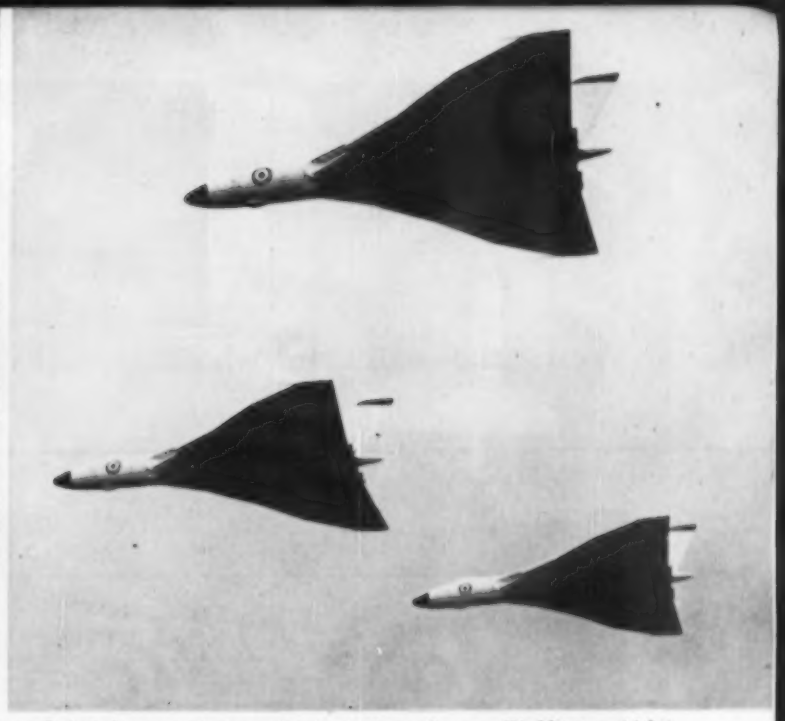
Three other RAF crews in the competition representing Britain will man Vickers Valiants drawn from the full squadron strength of No. 3 Group of Bomber Command.

Vulcan B Mk. 1 Delivered

Current deliveries are Vulcan B Mk. 1 versions powered by four Bristol Olympus 104 turbojets rated at 13,000 lb. thrust each without afterburner. First deliveries to the RAF began in mid-1956 with planes sent to No. 230 OCU at Waddington.

No. 83 Squadron started getting its Vulcans this year.

Service Vulcans now have racked up more than 1,000 hr. of flying time,



FIVE-MAN crew enters Vulcan (left). Door does not blow off, but drops as slipstream break. Vulcans fly over Waddington (right).

'Teething'

enough to develop any of the bugs that usually plague new aircraft entering squadron use. But the RAF says this airplane has had fewer teething troubles than any other they've received in the past decade.

No single Vulcan has developed trouble that kept it on the ground more than two days, and there have been no mass groundings.

Later versions of the Vulcan will be designated B Mk. 2 and will use a new wing designed to improve both altitude and speed performance. Powerplants will be Bristol Olympus 200-series turbojets rated at 16,000 lb. each without afterburner.

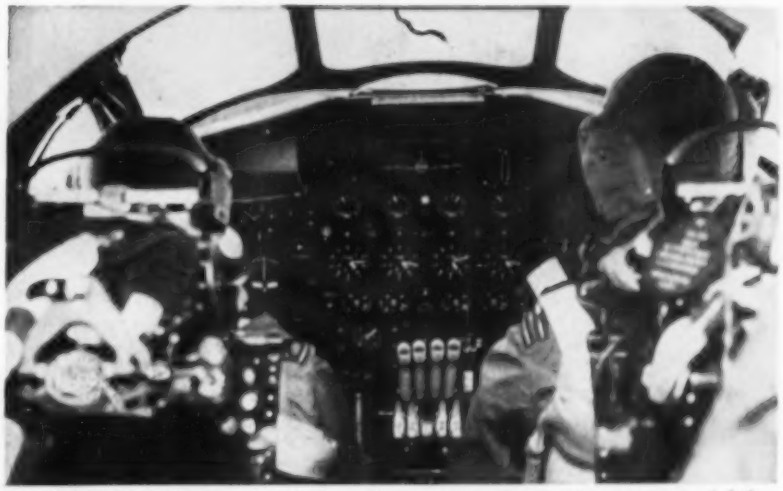
Expected offensive armament for the Mk. 2 will include an air-to-surface missile being developed by Avro's guided missile group.

Vulcan Crew

Normal crew complement is five: first and second pilots, plotting navigator, bombing navigator and electronics officer.

Each airplane has its own crew chief, a common practice in air forces the world over.

Crew selection for the Vulcans parallels that of USAF assignments for SAC crews. Top assignment in Bomber Command now is to be first pilot of a Vulcan. For that job, a pilot must have a minimum of 1,750 hr. flight time as a first pilot, plus a tour of duty



INSTRUMENT LAYOUT (top) includes indicator giving pilot visual presentation of deflection on trimmers, ailerons and elevator (top instrument above console). Rpm., set at 6,200, is less than cruise for Olympus engine. Two structural doors open for engine access (below).

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** Builder W. T. Piper, Pres., Piper Aircraft Corp.; Owner Allen F. Edwards, Jr., Manufacturers' Representative, Detroit, Mich.; Veteran Pilot Jack Gregson, seen on "Wednesday Night Fights" (ABC-TV); Service Manager E. R. Schubert, Gopher Aviation, Inc., Rochester, Minn.*

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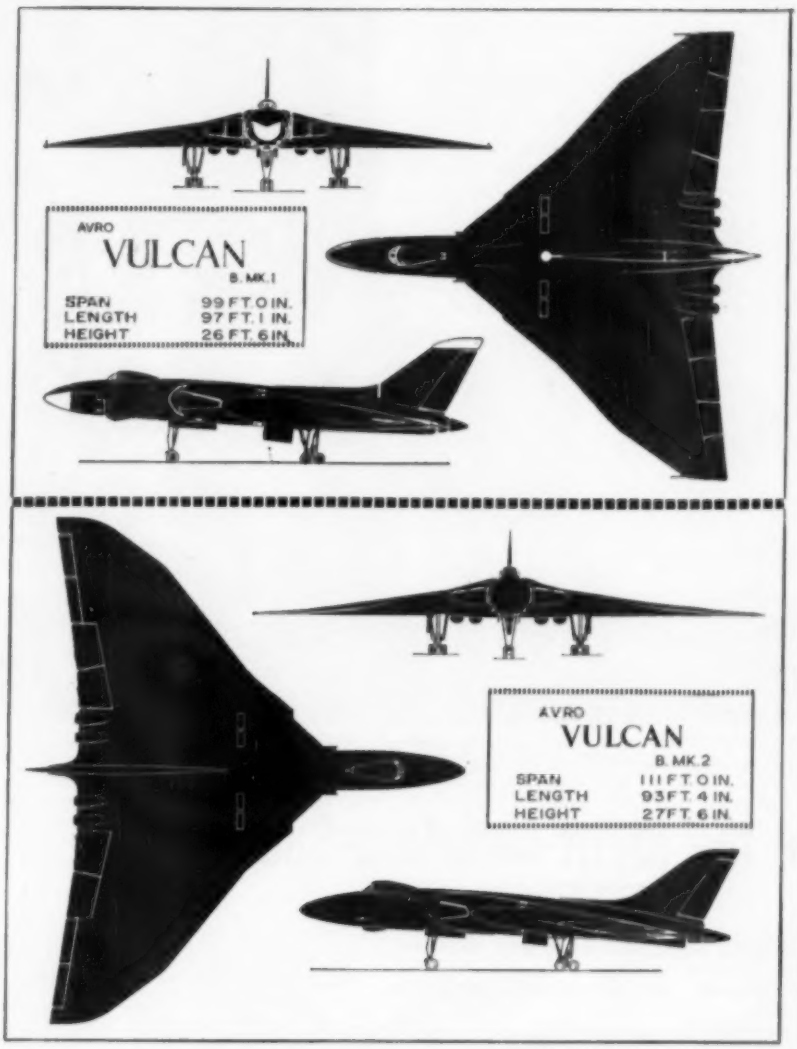


in Canberras. Four-engined experience is desirable, says the RAF.

Second pilots need 700 hr. as a first pilot in their logbooks, plus a Canberra tour. Navigators must have completed a tour with Canberras also, and the bombing navigator must have gone through the command's training school. Electronics officers usually are required to have completed duty with either bomber, transport or coastal command.

Ground crew are all volunteer airmen who have gone through the RAF technical college plus the air electronics school.

Crew Training

Training course at an operational conversion unit working up to Vulcan duty lasts 12 weeks. First phase for pilots is a four-week ground school on the Vulcan and its systems, primarily concentrating on flight planning and cruise control.

Second pilots specialize on such systems as they operate during flight—fuel, cabin pressurization, powerplant. A similar routine applies to navigators and electronics officers in their specialties.

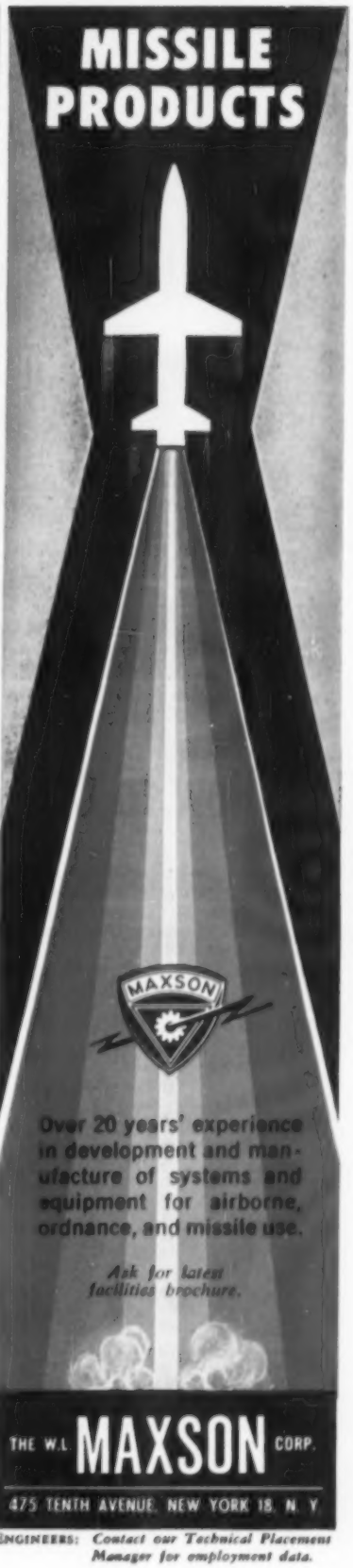
Flight simulator time begins near the end of this first phase of training. Pilots get 15½ hr. simulator time before actually flying the Vulcan and a further seven hours after flight check-out.

Variable Lighting

One different feature of this simulator is that the nose section is contained in a shell that has variable lighting. These lights can imitate external intensity of atmospheric lighting from bright high-altitude daylight to dark or moonlit nights.

Two additional weeks of ground school start off the second phase of flight training, and during this period, the first familiarization flights are made in the Vulcan.

Six weeks of intensive flying in the airplane concludes the course. These begin with two hours of high-altitude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George A. Phillips, author, with General Electric's advanced constant-speed drives. Left, 73-pound, 20-KVA hydraulic constant-speed drive and generator package. Right, 110-pound, 60-KVA turbonator (power turbine and high-speed alternator on a common shaft).

How to Choose the Right Constant-Speed Drive

General Electric engineer outlines method to help determine which constant-speed drive—hydraulic or air-turbine—best suits requirements of particular aircraft

By George A. Phillips, Manager

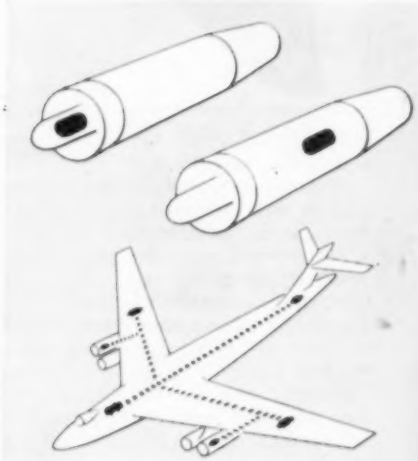
Systems Engineering, Aircraft Accessory Turbine Dept., General Electric Company

Providing a source of adequate, precisely controlled a-c power—with minimum aircraft performance penalty—is a challenge to the aircraft designer. Electrical loads continue to increase, yet airframes require lighter, smaller, simpler-to-operate power systems with automatic fault protection.

Today, engineers are recognizing the increasing importance of the power drive, and looking closely at the comparative advantages of hydraulic and air-turbine drives.

Both hydraulic and air-turbine drives are reliable, efficient

In general, there are few differences in performance between the two types of drives. Both hydraulic and air-turbine drives offer aircraft a reliable source of constant-speed power. To get *optimum* performance from a particular aircraft, however, the relative merits of each drive system must be carefully matched to the requirements of the plane . . . its mission and power plant characteristics, temperature environment, space and weight



LOCATION IS ONE CONSIDERATION. Hydraulic drive can be mounted directly on engine nose or waist pad with generator (top). Air-turbine drives can be located on engines or in wing or fuselage area (bottom).

limitations, and reliability.

To help aircraft designers select the drive system that will give their planes this optimum performance, General Electric's Aircraft Accessory Turbine Department offers assistance in each of the following steps in the selection process:

1. Establish alternate drive system configurations.

Initial drive system layouts depend upon an analysis of plane configuration, power plant, accessory power needs, and mission including starting and ground handling . . . factors apparent early in the airframe design stage.

At General Electric alternate configurations will be proposed by a group of engineers with broad experience in the design and application of both types of drives, plus a knowledge of electrical system coordination and protection.

2. Study boundary conditions and size components.

Drive system boundary conditions include the input from the power plant, characteristics of the power distribution system, loads into which output is fed, and environmental conditions with particular reference to heat dissipation and cooling. The system analysis includes a thorough evaluation of these boundary conditions and their effect on the design of accessory power system components. Overloads and fault clearing loads imposed by the electrical system, for example, must be matched by a drive which will deliver this output under all required engine operating conditions.

Calling on the IBM 704 computer, General Electric engineers determine maximum fault torques in terms of alternator sequence impedances and type of excitation system. This simplifies the problem of determining the best safe compromise between unbalanced voltage performance with unbalanced phase loading and fault current capability on the one hand and drive and engine penalties on the other.

3. Analyze weight penalty of each drive.

After the several system configurations have been defined, total weight penalty—system's installed weight plus weight of fuel necessary to compensate for power extraction plus drag chargeable to system—then becomes an important comparison basis for drive selection.

To assist the airframe manufacturer in this phase of the selection process, General Electric systems engineers team up with computer technicians to deliver facts and figures on both drive systems. Expected accessory performance, variables in mission profile, load demands, airframe and engine performance, and weight of system components are some of the factors which may be programmed into the IBM 704 electronic "brain."

4. Consider special requirements.

Choice of a system extends beyond quantitative investigation. Special considerations—installation and maintenance, unusual operating requirements, number of power plants and drives, effect of related starting and air-conditioning systems—must be studied carefully. Operating advantages obtainable from each type of system must be evaluated and matched with the particular application before the best drive can be chosen.

. . . and after the right drive is chosen . . . Developing the prototype, and translating it into proven production models, are tasks that call for broad experience and modern facilities.

Today, at General Electric, constant-speed drive engineering and development facilities—10 test cells, 65,000 sq. ft. of development floor space, 500,000 sq. ft. of production floor space—are combined "under one roof" at G.E.'s Lynn, Mass., plant. This integration centralizes technical know-how and product versatility . . . and adds up to one more reason why General Electric is qualified to help assure that the *right* choice is made, and the *right* drive produced.

For more information about specific products of the Aircraft Accessory Turbine Dept., check with your nearest G-E Aviation & Defense Industries Sales Office. ***General Electric Company, Schenectady 5, N. Y.*** 231-15

ANALYSIS performed in early design stages by General Electric engineers is later programmed to IBM 704 computer to help customer select power drive system that best meets requirements of aircraft.

QUALITY REQUIREMENTS of drive components are assured by modern methods and equipment used throughout half-million sq. ft. of production floor space at G.E.'s Aircraft Accessory Turbine Dept.

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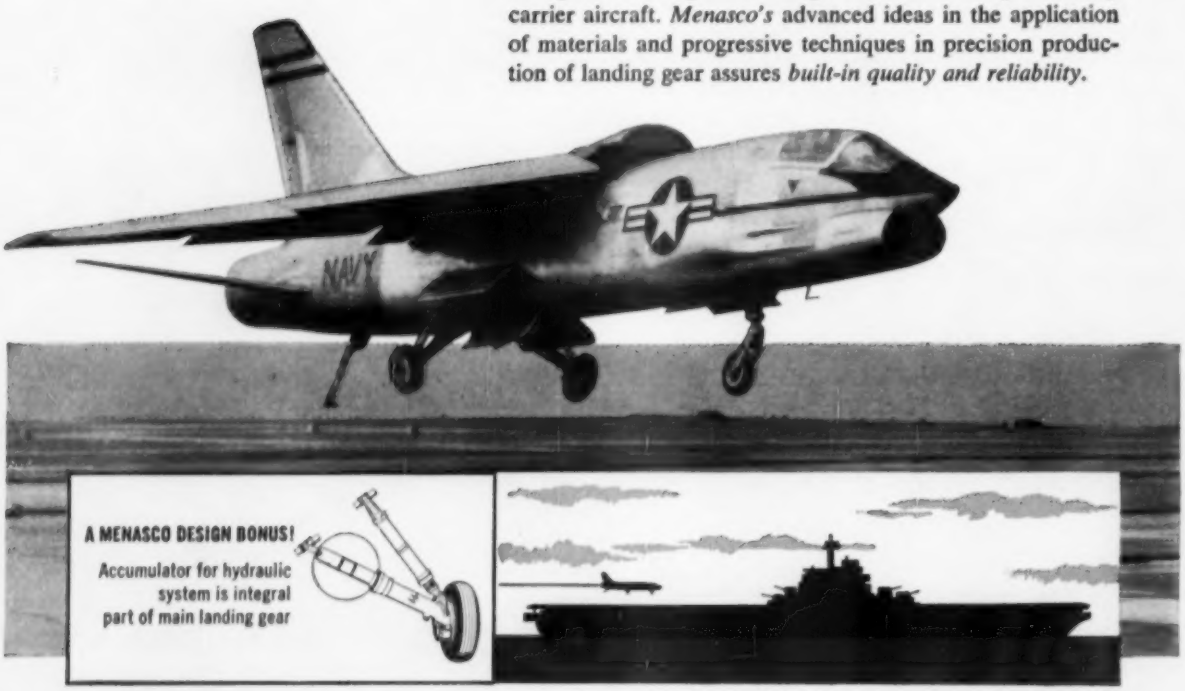
MENASCO was chosen to fabricate the *Chance Vought Crusader* landing gear and not only *met* but *exceeded* all requirements. The gear is the lightest, strongest and most compact of any carrier aircraft. *Menasco's* advanced ideas in the application of materials and progressive techniques in precision production of landing gear assures *built-in quality and reliability.*



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flight to demonstrate handling characteristics, followed by a series of landings.

First cross-country follows, and then come emergency procedures. The trainee captain with his own second pilot takes over the control solo on the third exercise.

Total course flight time is 50 hr., and about half that is night flying. The course also includes flight time in Canberras to develop instrument landing system approaches.

Lengthy Checklist

The complexity of a modern air weapon system is reflected in the length of the takeoff checklist. Before the engines can be turned over there are 108 items to be checked internally. These cover the obvious, like taking off the covers to the engine inlets and exhausts, or the subtle, like checkout of the avionic gear by the electronics officer.

To start the engines is a 31-step procedure. Before taxiing, the list includes another 27 points, and finally the pilots run through a 21-item takeoff checklist.

Flight characteristics of the airplane have been singled out for praise by its pilots. All controls are power-operated with artificial feel from a spring between the control column and the flying surface power units. Spring tension is varied with changes in indicated airspeed (Q-force system). If the power boost system fails with full spring force acting, there are relief buttons in the cockpit which relieve the tension in the spring so that normal forces can be obtained for landing.

Maneuverable Aircraft

Demonstrations of the Vulcan at Farnborough have always been indicative of the flying qualities of the plane.

Every spectator remembers the time that Roly Falk, Avro's superintendent of flying, roared across the field low and pulled the huge delta into an upward roll. Short takeoff and landings—admittedly with the plane flying well below its normal gross weight—have been impressive.

Overhaul of the Vulcan is geared to a 100-hr. check period, with the first major coming at 600 hr. Overhauls at the odd hundred hours are called minor overhauls and those at the even hundred are called minor star overhauls.

Volunteer RAF airmen are used as the basis for ground crews because of the long training period and the desire to hold the man on the job as long as possible. Advanced grades of mechanics in the servicing crews take a course on the Vulcan at the Avro plant, and the lower grades are instructed at Waddington.

One of the most famous of all

LINDSAY PRESSURE GAUGE used in jet aircraft. Model #6907-1 shown here in actual size; total weight .20 pounds. (Other models for missiles and special applications.)

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Bomber Command squadrons, No. 617—known as the Dam Busters from their operations against the German watersheds during World War II—is being reformed next year with Avro Vulcans. The squadron, disbanded last year amid protests from every quarter, should get its Vulcans soon and be ready as an operational unit early next year.

Basic concept of the Vulcan, although now almost 11 years old, was advanced for its day. Originated by the Air Staff and issued on Jan. 1, 1947, the requirement called for an airplane with large bomb capacity, long range, the ability to cruise at extreme altitudes—as much as 60,000 ft.—and to make the bombing run at transonic speed.

Design Start

Avro's design team, under the direction of S. D. Davies, began the layout of a series of shapes to meet the specifications and eventually decided on the delta layout as being best suited. The same specification issued to Handley-Page produced a geometry based on the so-called "crescent wing" concept, in which wing sweepback is reduced as a function of span increase.

Davies and the project team completed their basic design in the fall of 1947, and were faced with the problem of having no flight-test data to check or confirm calculations for their Type 698 delta-wing bomber. So they turned to the development of a line of research aircraft, built to one-third scale, which would be used to develop as much of the proposed flight envelope as possible.

Experimental Deltas

Five of the little deltas—designated Type 707—were built to various configurations and purposes. The first flew on Sept. 4, 1949, just making the Farnborough display that year. But it was lost in the air later and not until the next September was the second delta ready to fly. It too just made the Farnborough show, flying in over the fence late in the evening of the first day. This second ship was a 707B and had, like the first, a dorsal intake well behind the cockpit.

Third in the series, a highspeed 707A with wing roof inlets which were prototypical of the big bomber, flew in July 1951. Two of these configurations were built and flight-tested at speeds up to the transonic.

The bomber design, fed by data from

Shorter Fin Tested on B-52

Vertical tail surface six feet shorter than on production airplanes is being tested on a Boeing B-52A Stratofortress. Success of the airplane's cross-wind landing gear permitted tail surface reduction, with potential weight, drag saving which will improve range and performance characteristics in future production airplanes (AW May 13, p. 23).

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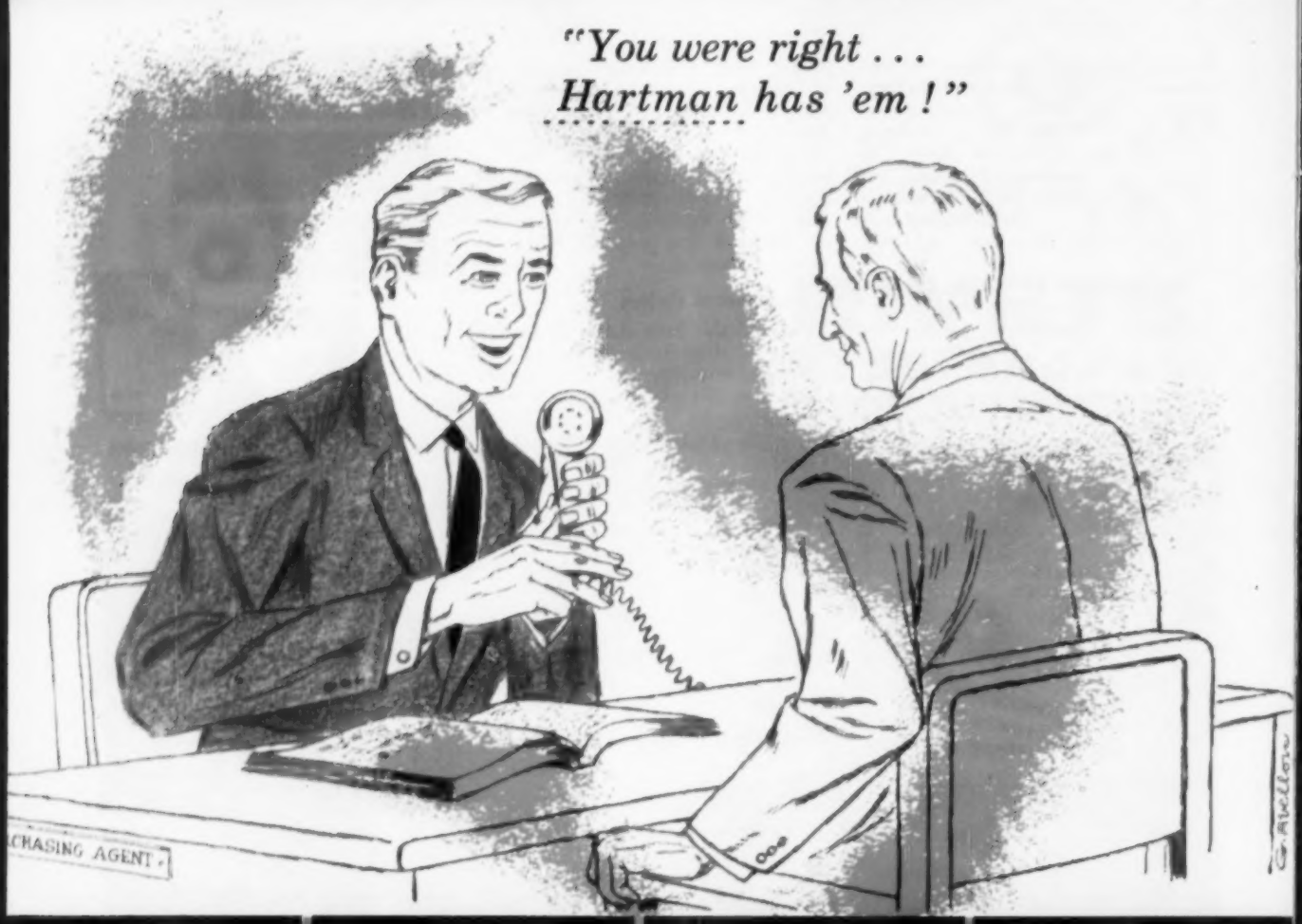

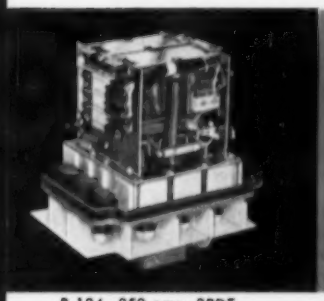

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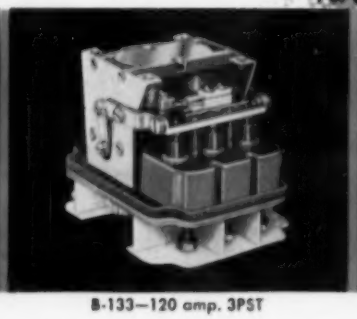

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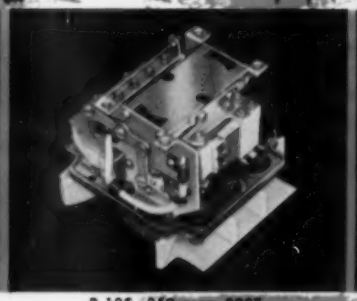

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the little deltas, was completed in April, 1950, and the drawings were released for construction.

Powerplants specified for the production airplanes were the two-spool Bristol Olympus, but the engines could not be ready for the prototypes. Consequently the first prototype was built around the thrust of a quartet of Rolls-Royce Avon RA. 3 turbojets, rated at 6,500 lb. thrust each, or about half the design figure.

Prototype Success

Underpowered and well below design capability, the first prototype 698 took off on its first flight August 30, 1952.

Trailed by the little research deltas, it flew over the Farnborough display a few days later in the first of a series of memorable displays of the plane in successive years.

Fifth and last of the research deltas, the two-seat 707C, flew in July 1, 1953.

It was designed and built for flight familiarization.

Second prototype of the Type 698 was powered by four Bristol Olympus engines, developing about 9,250 lb. thrust each, well below their eventual figure.

The plane flew Sept. 3, 1953. Meantime the first prototype had been re-engined with Armstrong Siddeley Sapphire ASSa. 6 turbojets rated at 8,000 lb. thrust each.

Only other visible change in the second prototype was the addition of a visual bomb-aiming position below the nose which has since been adapted as standard for the line.

Production Vulcans

First production airplane flew in February, 1955, and was followed into the air shortly after by the second.

These first four airplanes off the Avro line were all "pure" deltas; that is, they did not have any modifications or fixes that altered the lines of the stark triangular planform.

They measured 99 ft. from tip to tip, and 97 ft. from nose to tail. Overall height to the tip of the fin was 26 ft. 6 in.

These "pure" deltas ran into aerodynamic troubles, as have most of the triangular shapes designed so far. Biggest worries revolved around the altitude performance, where the plane had to fly at high angles of attack to develop the necessary cruise lift coefficient. At 60,000 ft., for example, the lift coefficient for the Vulcan at Mach 0.9 is on the order of 0.6; for a 40,000-ft. cruise altitude and a speed of Mach 0.7, the lift coefficient is about 0.4.

High lift coefficients meant high drag due to lift (induced drag) and an additional increment of profile drag due to the angle of attack. Clearly this drag had to be reduced to improve the performance of the Vulcan.

The drag reduction took the shape of a modified wing leading edge somewhat in the style of NACA's conical camber used on the Convair F-102/106 series and the B-58. That modification did several things: it increased the wing area a little, it reduced the thickness-chord ratio a little, and it increased the camber of the leading edge a lot. The net result was that the induced drag component at high cruise lift coefficients was reduced to a more tolerable value, and the ceiling of the airplane was also increased.

The kinked leading edge was flown as a modification on the second prototype in October, 1955. It has since been built on all of the production airplanes.

Wing Change

Latest aerodynamic modification is what appears to be a completely new wing fitted to the second protoype and demonstrated this year at Farnborough. This Vulcan is an aerodynamic prototype for the B Mk. 2 production versions, and like so many of the Avro deltas before it, flew just before the Farnborough display but in time enough to make the demonstrations.

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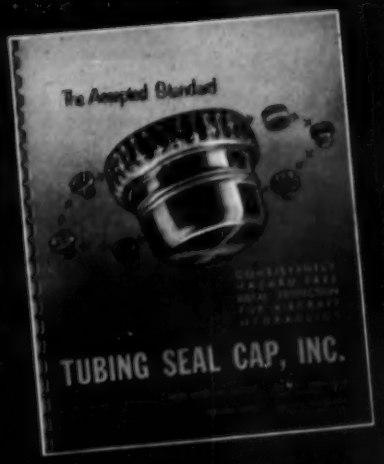

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departure from the delta layout and begins to resemble the "curved delta" geometry used on the Douglas F4D Skyray series.

Area and span have been increased; the wing tips are of larger chord and rounded at the leading edges. The leading edge is extended and cambered.

Slight sweepback of the original trailing edge has been increased beginning at about 40% of the span outboard. The trailing edge shows what appear to be three separate and distinct degrees of dihedral, but it is possible that the outboard "dihedral" is deceptive because of what appears to be a considerable amount of wing twist toward the tip.

Engine Test Bed

In addition to this aerodynamic prototype B Mk. 2 and a standard B Mk. 1 production Vulcan flown at Farnborough, Rolls-Royce demonstrated a Vulcan used as a test bed for the Conway bypass engines in production for the Handley-Page Victor.

The plane was the original prototype now in its fourth major powerplant change. Avro did the conversion, flew it on Aug. 9 and delivered it to Rolls-Royce at the company's Hucknall flight development center on Aug. 24—once again in time to make a Farnborough display appearance.

Vulcans of Bomber Command also roared over the field during the display, emphasizing that the airplane is in service with the RAF. The Vulcan is called the world's fastest operational bomber, primarily because it has indicated sonic speeds during test flights. In fairness to Avro, the company has never said that the delta ever exceeded sonic speed.

Handley-Page Promotion

Handley-Page, however, has been plugging its line of "higher–faster–farther" for the Victor for years and recently announced that the Victor had exceeded the speed of sound on a test flight. The company's stand at Farnborough further pressed the point, and said the Victor was the biggest aircraft in the world to have done so. Position error curves for the Victor's pitot installation were not exhibited.

Vulcans are in full production at Avro's huge factory near Manchester. Major components for about one dozen ships are on the line at any one time, judging by photos recently available.

As Vulcans become available, they are to be delivered to squadrons within No. 1 Bomber Group, which will operate them and the remnants of the Canberras which are still serving Bomber Command. No. 1 Group will receive the Handley Page Victor and currently operates the Vickers Valiant.

PHOTO — COURTESY U S AIR FORCE

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with feet still on the ground

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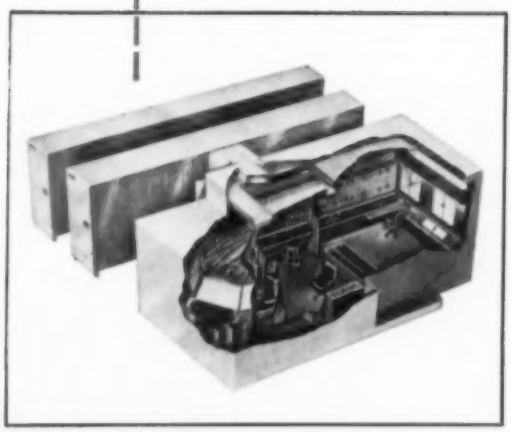

The recent globe-circling feat of the SAC, B52 in the amazing time of 45 hrs. 19 mins. could have been 5 to 6 hours less — if the all jet KC-135 had been in operation to perform the refueling. Very soon the KC-135 will become fully operational and the crews of these giant 500 mph. tankers will be *fully trained* — thanks to the ERCO Flight Simulator. ERCO — one of the recognized leaders in the field of synthetic training devices was selected to design and build the KC-135 Simulator.

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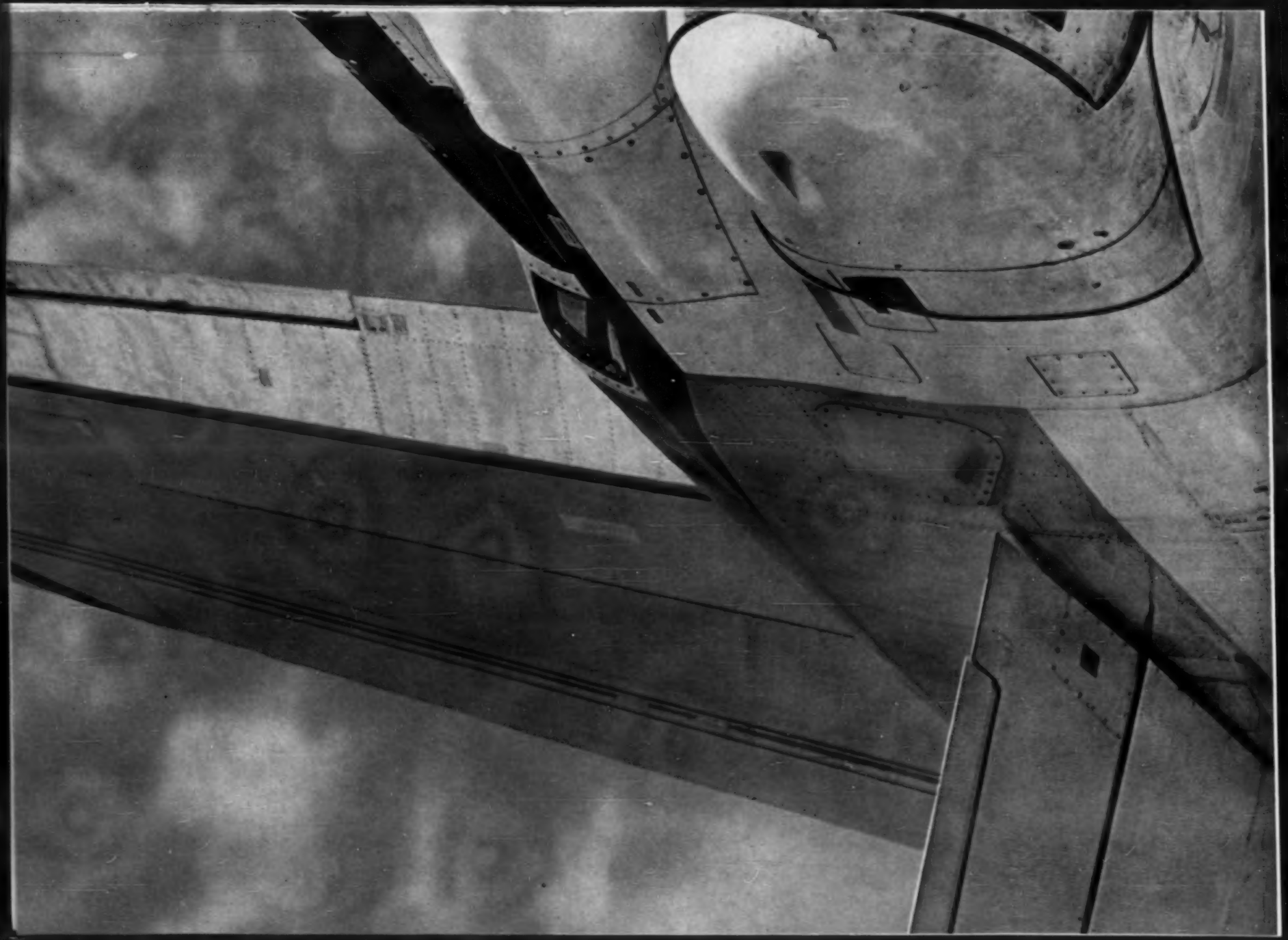

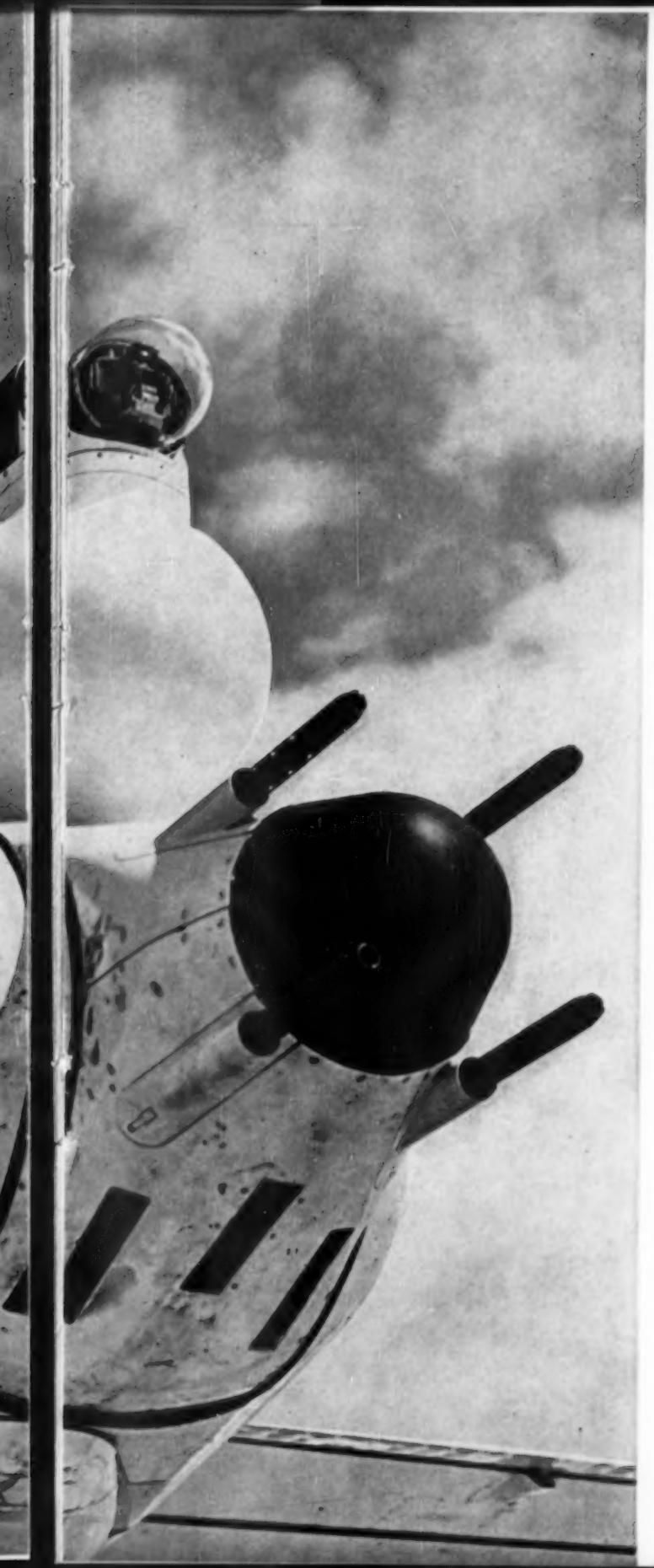

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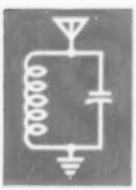

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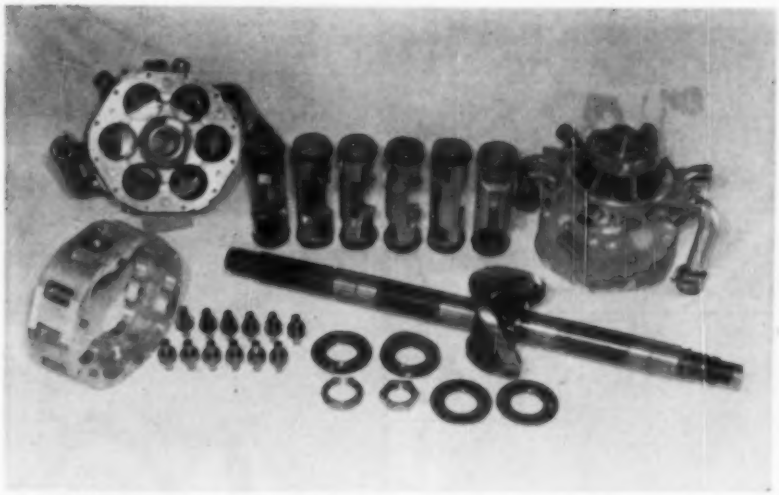
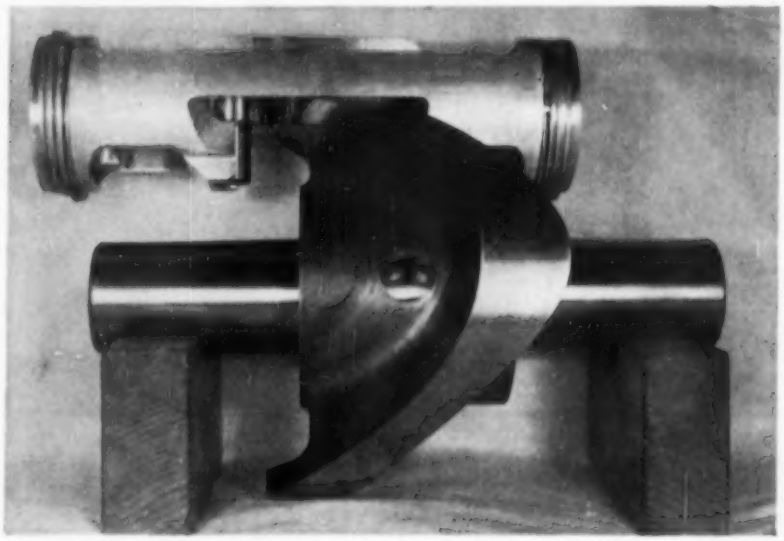


RECIPROCATING motions of six double pistons in X375 engine are transferred to main shaft by cam at the middle of main shaft which engages center of each piston.



Airworthy Cam-Type Piston Engine Has Low Frontal Area, Few Parts

Manufacturer of a cam-type piston engine that has been rated airworthy by the Civil Aeronautics Administration predicts that the engine will prolong the use of piston engines in lightplanes despite advances in small shaft turbines.

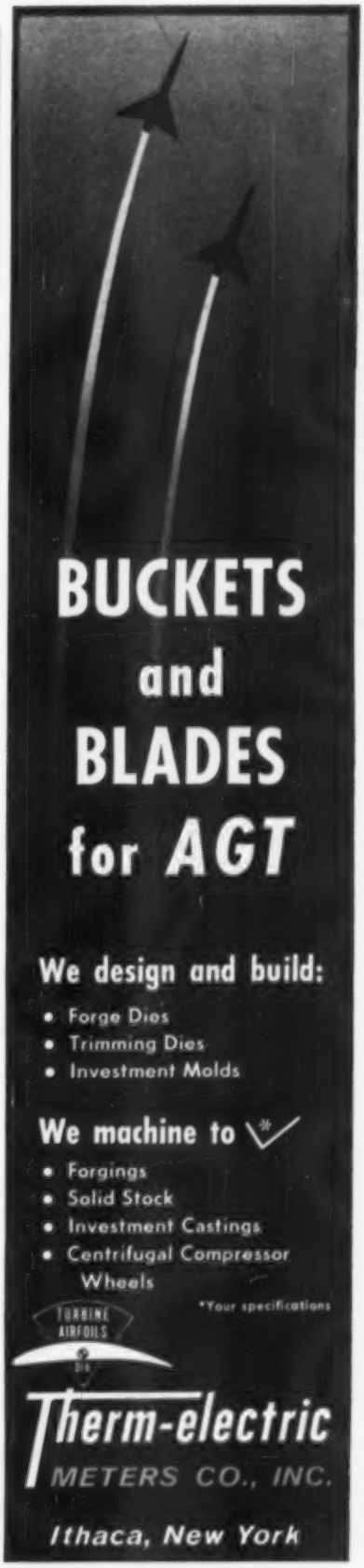
Developed by the Herrmann Engineering Co., Glendale, Calif., the X375 cam-piston engine uses an arrangement of six double pistons working parallel to the main output shaft. The reciprocating motions of the pistons are transferred to the main shaft by a cam at the middle of the main shaft which engages the center of each double piston.

Advantages claimed for this configuration are lower frontal area, less vibration and fewer parts.

Dry weight of the 200-hp. certification model is 338 lb., equipped with a starter and generator. Maximum continous hp. is 175 at 18,000 ft. altitude. The compression ratio is 8:1 and the manufacturer's specific fuel consumption curve dipped to about 0.46 at just under 200 hp. The X375 is liquid cooled.

Manufacturer says that two aircraft builders are considering using a cam-piston engine for future models.

Concerning reasons why cam-piston engines have not been popular up to this point, Karl Herrmann, head of the



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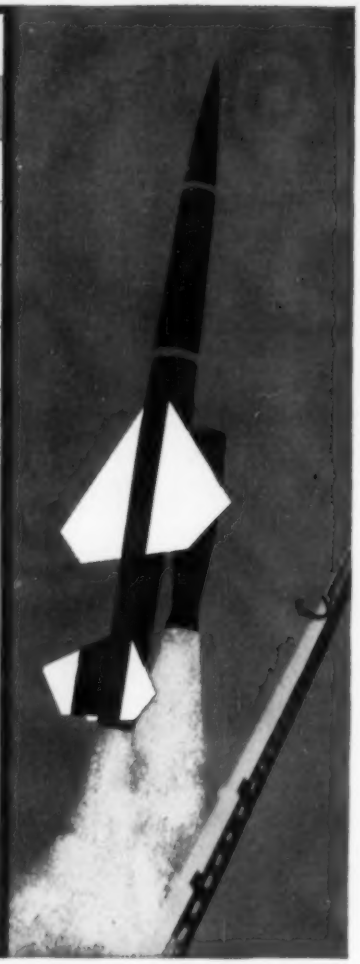

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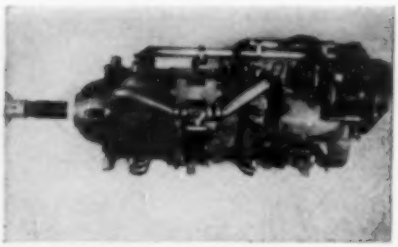


DRY WEIGHT of 200-hp. Herrmann Engineering Co. engine is 338 lb. with starter and generator.

firm, told AVIATION WEEK, "many organizations have tried to make an engine of this type but we know of none that were able to keep one running more than a few minutes before failure. It is possible that insufficient study of detail and lack of persistent application caused the failures. I think that we have nothing basically new."

Curtiss Negotiates License for Iroquois

Curtiss-Wright Corp. and A. V. Roe Canada Ltd. confirmed that an agreement has been signed covering the rights for manufacture, sale and further development of the Iroquois jet engine in the U. S. as predicted in AVIATION WEEK (May 27, p. 23 and Sept. 9, p. 101). Curtiss intends to use the Iroquois in USAF interceptors, as North American's F-108, which are expected to materialize as soon as USAF "shakes down its new mission requirements."

Iroquois uses 3,500 lb. weight to develop 23,000 lb. thrust, without afterburner.

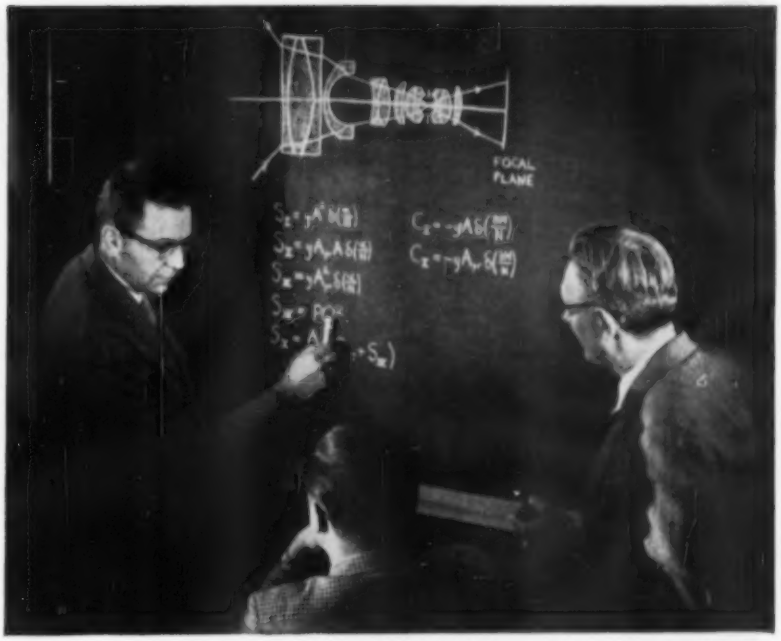
Visiting ADC Interceptors Assured Priority Servicing

Operation Popcorn is name of program initiated by 20th Air Defense Division to assure fast turn-around and clearance of division planes on air defense missions that put down at bases of Strategic Air Command, Air Training Command, Air National Guard or Air Force Reserve.

Participating bases have pledged cooperation in reducing ground time and providing prompt service for a 20th Air Division supersonic fighter interceptor that is recovered away from its home base, Richards-Gebaur AFB, Mo.

It is hoped that Operation Popcorn will cut ground time to a minimum and provide the urgent services essential to a visiting interceptor that may be required to scramble in a hurry.

The 20th Air Division expects that its combat potential and effectiveness will be increased by the program.



Dr. Nisson A. Finkelstein discusses CinemaScope equation with Harold Straat and Donald Mortimer

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Lunar craters as seen through an astronomical telescope.
The puzzle of what's on the other side may soon be answered.

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Ever since man has had the imagination to ponder *any* problem, he has wondered what lay on the dark side of the moon . . .

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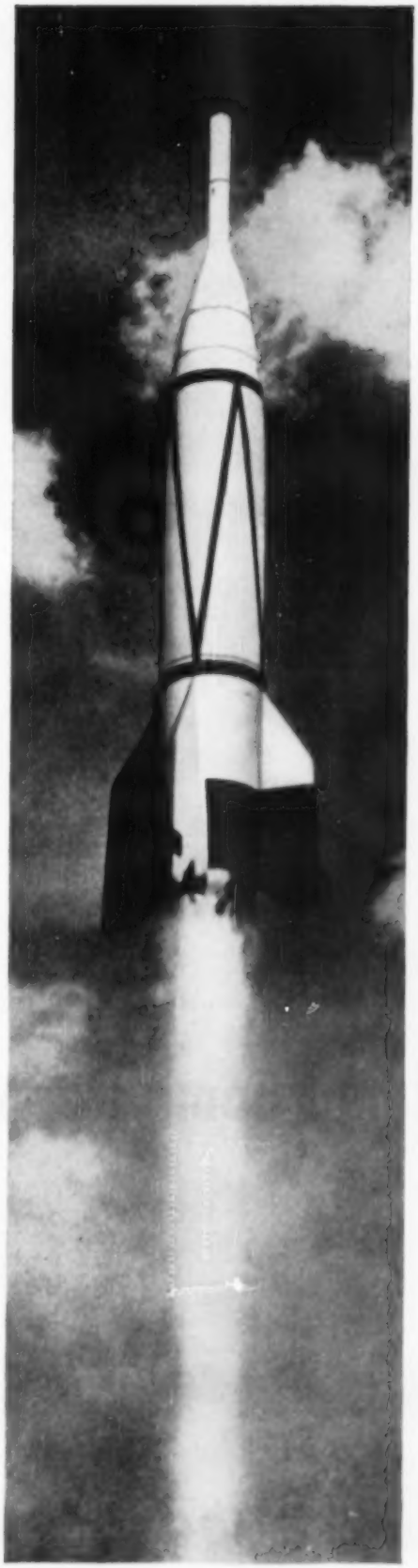
At Douglas Aircraft, where one of the first rocket and missile projects was set up in 1941, practical investigations have helped show the way to lunar circumnavigation. They have led to more effective missile guidance systems . . . helped establish basic principles of air-to-air rocket fire . . . led to use of such heat-resistant materials as titanium, ceramics, and plastics. Douglas engineers have investigated *space physiology and psychology*—how man will react in the weightfree glare of space—and even investigated new kinds of power, engines that may use ions or light rays to reach the stars.



Wac-Corporal, an early Douglas rocket, takes off in the nose of a captured V-2 to set what was then a world altitude record. Douglas has since developed such weapons as *Nike*, the new *Nike-Hercules*, and the Army's potent *Honest John*, which can carry a nuclear warhead. Even more exciting projects—still classified—are going full speed ahead at Douglas.

Depend on

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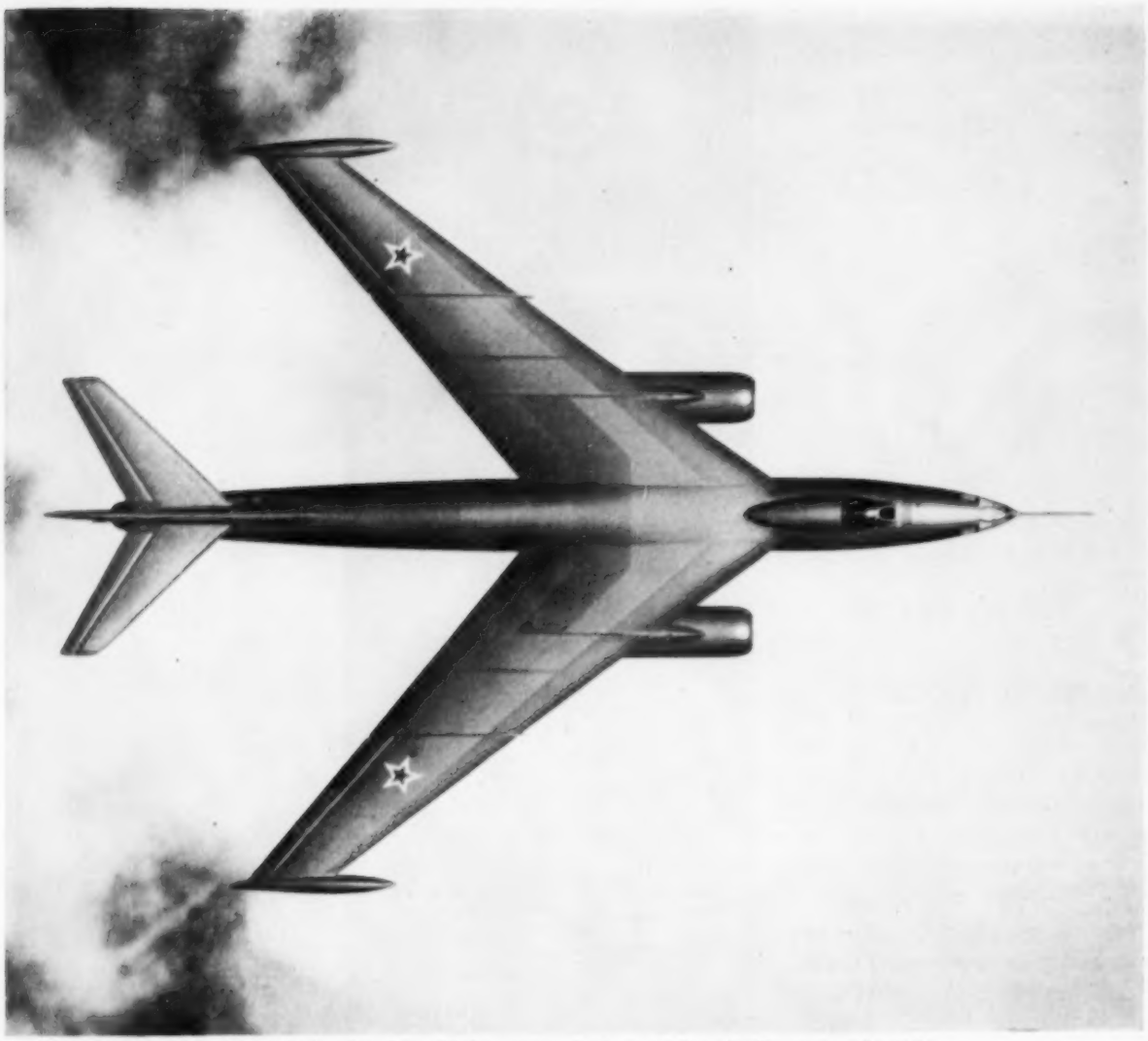
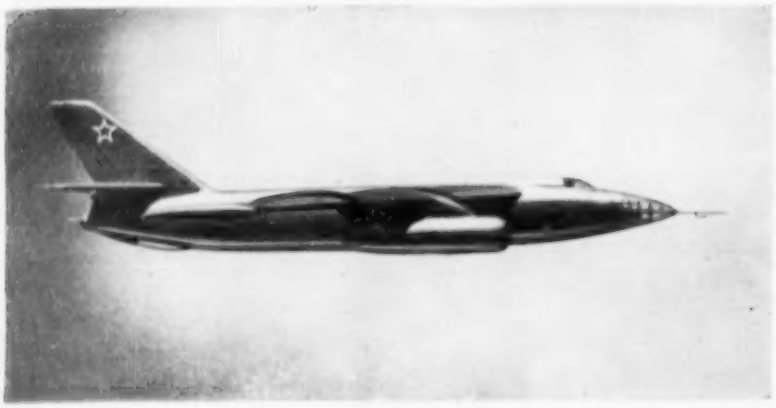
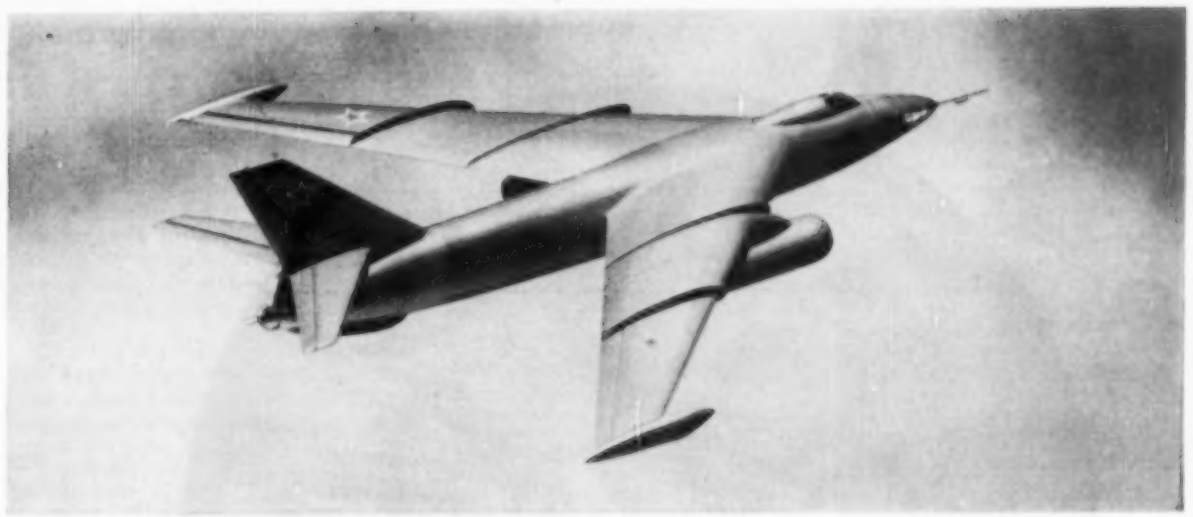


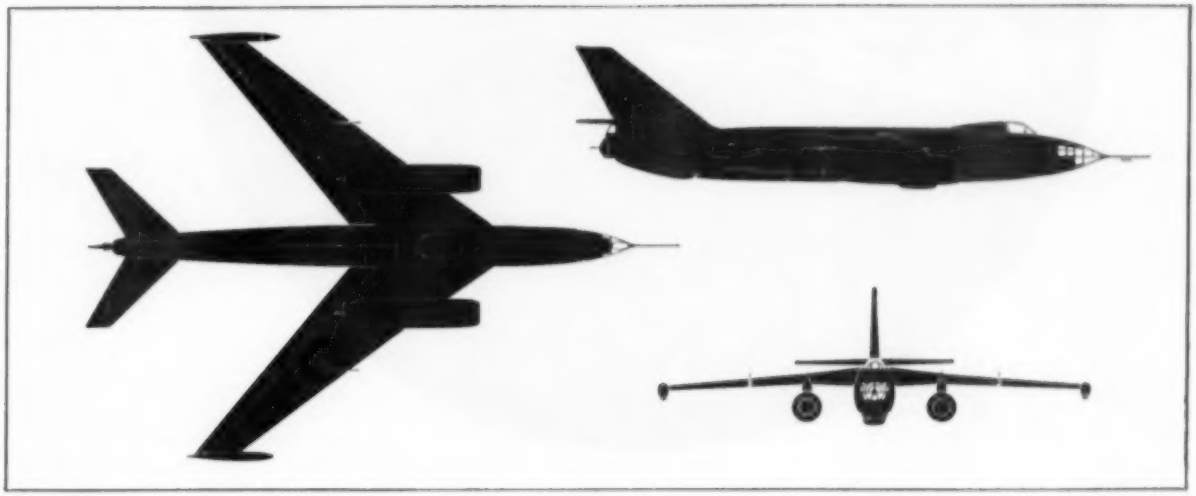
Plan view of Russian Blowlamp light bomber shows 55 deg. sweep of wings, outrigger landing gear pods at tips.

Soviet Blowlamp Compares With U.S. A3D



Soviet Blowlamp light bomber is powered by two axial flow turbojet engines and is estimated by Navy to be capable of Mach 1 plus performance in a shallow dive. In the same class as the Soviet Il-28 Beagle, it is comparable to the U. S. Douglas A3D Skywarrior. Wing is shoulder mounted with two wing fences on each side. Outrigger landing gear pods are at tips. Vertical tail is sharply raked and squared off on top; twin ventral fins or skids are visible, these Navy models show. Span is 57 ft., length 70 ft.





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And, we build radar antennas and related equipment to help our submarines to defend themselves.

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Aviation Week Check Flight:

Electra Engines Perform Well in Flight

By Richard Sweeney

Burbank—Differences in flight characteristics which pilots used to piston engines will encounter flying Lockheed's turboprop Electra transport should find favor if indications given by company's current flying test bed hold true.

Test bed is a Navy R7V-2 bailed to Lockheed, in which company has installed four Electra Allison 501-D13 engines and Aeroproducts 606 propeller power packages for a 1,000-hr. flight test program under conditions approximating those of standard airline operations.

Although overall aerodynamic flight characteristics of the "Elation," unofficial title of the Constellation-with-Electra-engines, are far from those of the Electra itself, some outstanding differences could be felt while piloting the aircraft:

- **Rapid and large** additions of power yield quick results smoothly without the usual torque effects of piston engines.
- **In-flight simulated engine** failure produced less than expected yaw—minimal control deflections were necessary for correction.
- **Very good final** approach power change characteristics.
- **Overall powerplant** performance effects on flight characteristics were good, with less dissimilarity than expected from supposed inherent response differences between turbine and piston engines.

Reason for Difference

Design feature of the Electra power system primarily responsible for differences in flight characteristics is constant turbine and propeller rpm. in all flight conditions. Changes in power through the cockpit power lever are effected by changes in turbine inlet temperature and propeller blade angle, each as required in the proper proportion over the power spectrum.

Two basic turbine speeds are 10,000 rpm. for ground idle, with variations in propeller blade angle interrelated with jet thrust producing power for taxi, and 13,820 rpm. for all flight conditions from flight idle at 200 eshp. to maximum takeoff rating of 3,750 eshp.

Flight evaluation included sample takeoff, ILS approach and landing with short stop, by Lockheed chief engineering test pilot Herman Salmon. Then the AVIATION WEEK pilot took off, climbed to 9,000 ft., sampled various in-flight power change characteristics, experienced a sample power failure somewhat unexpectedly as fuel was shut off to No. 1 engine, flew with propeller in maximum drag position, then with propeller feathered, unfeathered propeller and re-ignited engine, returned to Burbank and flew conventional landing pattern under reduced visibility conditions, landed, taxied in and parked. Flight time approximated 1½ hrs.

A predominant characteristic of this turboprop test bed is acceleration. Application of takeoff power gave the aircraft a quick buildup to takeoff speed and, after liftoff, the usual feel change accompanying power reduction in piston engine planes was considerably less as turbine power was reduced.

Rate of climb to chosen altitude was good. Although test bed configuration precluded accurate indications of Electra performance and characteristics, indications were given of good margins in performance available using turboprop power in Constellations, a combination in which several potential customers are reportedly interested. Climb rates were somewhat above standard, while cruise speeds at approximately equivalent horsepower output percentages gave better than 20 mph. higher indicated air speeds consistently.

In-flight power changes produce results quickly but smoothly. Large power reductions are not followed by the sudden slowing effect of piston engines. The wide chord propeller blade results in a steadier slowing at a rate which still is fairly swift.

Reapplication of power produces a high acceleration along the plane's flight path without such piston effects as engine mass acceleration torque, and momentary propeller variations in rpm. at high settings.

Simulated Engine-Out

At simulated engine-out, a yawing tendency was felt as power ceased. Continued flight with the propeller in maximum drag position was not difficult. No attempt was made to trim out effects, but rather to fly with them for a better assessment of their values in this, the worst possible drag situation, where some 400 hp. is being applied in drag forces as engine windmills. Trimout was accomplished after feathering, and in the feathered condition, flight characteristics were standard, with no noticeable extra effects due to the dead engine and its low profile drag.

Unfeathering produced no unusual characteristics except that usual warmup period of piston engines after air restart was not necessary, eliminating one stage in return from engine-out to normal flight conditions. However, during unfeathering, a small pull was felt as propeller again went through the maximum drag condition as its windmilling pulled the turbine back toward operating rpm. and blade angle of attack passed from feather to flight regimes, both occurring prior to re-ignition of inoperative engine.

Conventional technique was used in descent to pattern altitude: engines were set at flight idle power. As power is applied to compensate for lowered gear and approach flap, together with pattern

Marine C-130 Refuels Jet

Lockheed C-130 Hercules, under Marine-Navy test at Patuxent River, Md., refuels McDonnell F3H-2N and Grumman F11F at 25,000 ft.

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is the best feature

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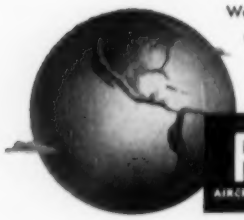
Long experience has led to Rohr's *world leadership in the design and production of ready-to-install power packages for airplanes.*

Furthermore, today Rohr leads in design and development in advanced aircraft structures programs such as years-ahead high strength weldments (shown below).

In aircraft components, experience is the best feature. It's a vital part of the 30,000 different parts built by Rohr.



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Assembly Plants: Winder, Georgia; Auburn, Washington

Career opportunities for engineers and technicians.

Taped Seams Cut Drag on F-102A

Parasitic drag on F-102A is reduced by 2½-in. strips of silver polyester tape which cover seams in leading edges of plane's wings. Tape is two mils thick, helps eliminate drag which occurs at supersonic speed. Access doors on fuselage were also taped to reduce turbulence at high speeds. Tape, which can be removed easily from doors for servicing, is being applied by 343rd Fighter Group, ADC, Duluth, Minn.

flight and final approach, advantages of Electra's turboprop power system became very apparent.

Use of the power lever, plus fast response without surge, makes final approach corrections easier. In the approach to Burbank, an S-turnback for runway alignment after a directional overshoot, plus power application with full flaps down to correct for an incipient undershoot, were accomplished. The power levers precluded usual interplay of throttles, propeller controls, mixtures, and, in addition, the response was immediate, adequate and smooth when power correction was applied, with less than usual control deflections required to steady the aircraft compared with that necessary when equivalent power is applied to piston engines on final approach. Removing power after correction was again smooth enough so that attention to flight controls for actual landing was easier.

Test Bed Data

The test bed R7V-2 is basically a 1049 model Constellation which was beefed up to take Pratt & Whitney T-34 turboprops for a Navy evaluation program. Lockheed put T-34s into two planes each for USAF and Navy, is making data gathered in its current test program available to both services. The bailed aircraft was not modified for the 501-D13 installation, with a somewhat less-than-ideal aerodynamic and thrust line effect resulting. Nacelles for T-34 are wider, higher than those of 501-D13, so after 501 installation, differences in section were faired, leaving a cross-section area increase immediately behind the engines themselves and just ahead of wing. Also, thrust line of T-34s was on the wing, but 501 thrust line in test bed remains somewhat higher, resulting in unusual pitch trim changes with changes in air speed and power.

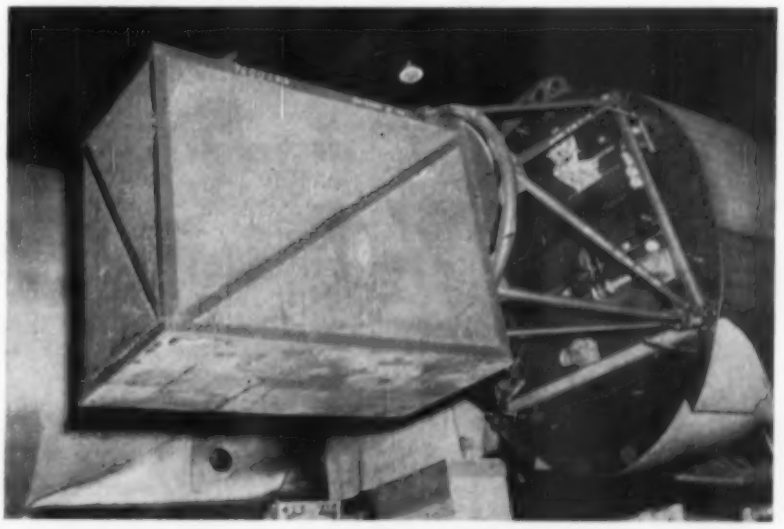
Features of the single power lever control system include variation of power by means of propeller angle of attack, turbine inlet temperature, fuel scheduling and sequencing of each according to power lever setting.

Power Settings

Two basic power lever settings are above and below an angle of 65 deg., with full open position considered as 90 deg.

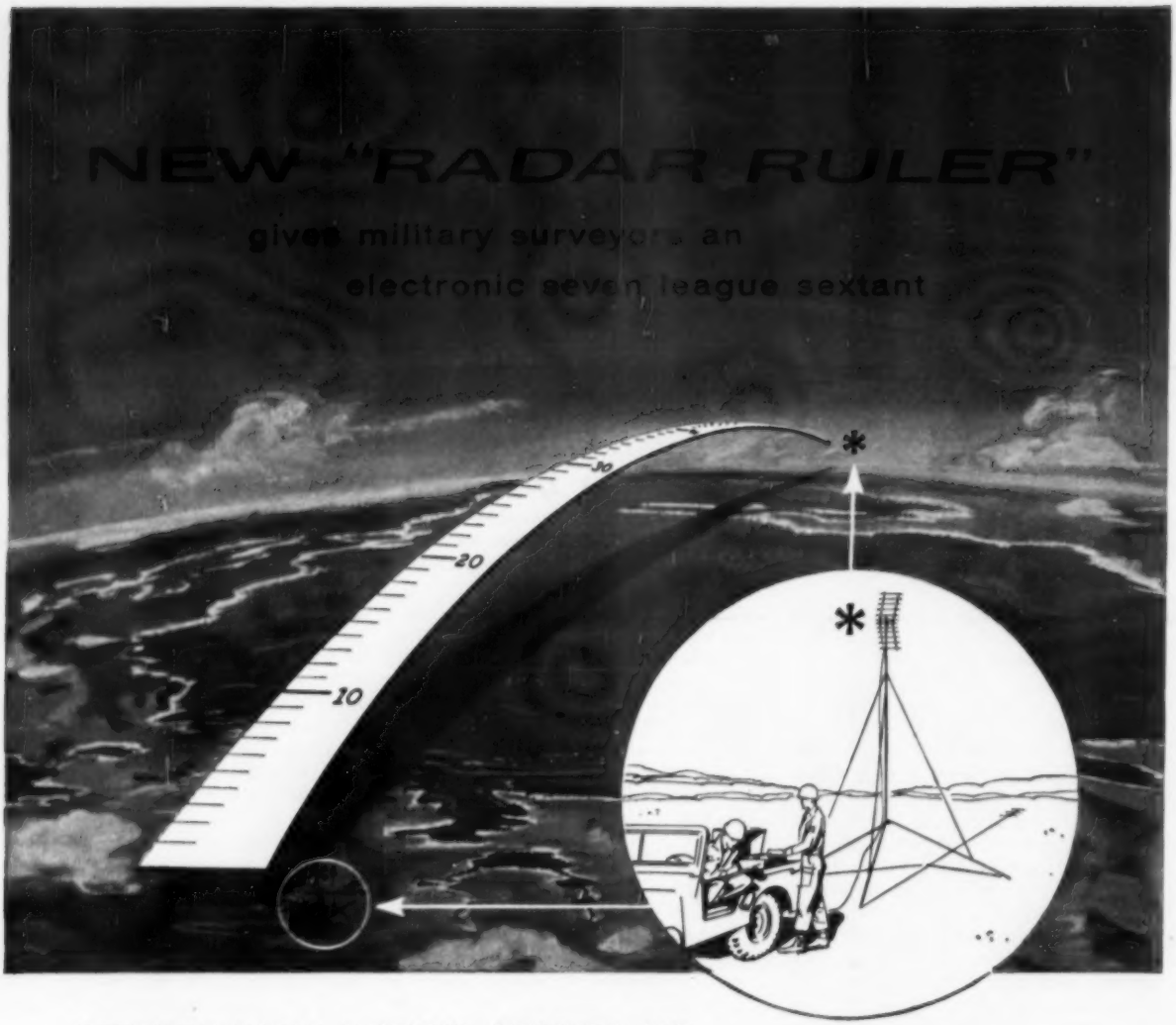
A temperature datum valve is an essential part of the system. At level settings of less than 65 deg., power is controlled by fuel scheduling to retain the desired rpm., with proper mixture for altitude, temperature and other factors computed automatically and compensated for.

Above the 65 deg. position, power level position calls for a certain turbine inlet temperature, with propeller blade angle changing to absorb greater power while retaining its own programmed rpm. and that of the engine at a constant level. And while a rough fuel scheduling is accomplished by the power lever above the 65 deg. setting, the temperature datum valve again performs in the system, acting as a fine fuel requirement trimming



Engine Mount Strength Test

Argus engine mount is tested by Canadair, Ltd., for strength by attaching a 7,600-lb. concrete block to the mount. Mount is attached to firewall by four bolts.



PORTABLE RADAR STATIONS MEASURE AND DOUBLE CHECK 50 MILE READINGS IN SECONDS

For the *first time*, surveyors are freed from short-sighted optical equipment. Unlike old-fashioned surveying tools, the "radar ruler" pierces through fog, darkness or dense foliage, electronically pacing off distances of 1 to 50 miles, precise to within a few meters!

This new general-purpose surveying instrument was developed by Motorola's Military Electronics Laboratory for the Signal Corps Engineering Laboratories, Fort Monmouth, N. J. The entire operation can be handled easily and quickly by unskilled personnel.

This self-calibrating system uses two identical portable radar stations which bounce a signal back and forth thousands of times each second. High-speed computers automatically provide the data necessary to measure off the distance.

Here is just one more example of the equipment now being developed by Motorola for many varied military applications.

3 suitcases and a 25 ft. collapsible antenna comprise the entire equipment

navigational devices • radar • countermeasures • microwave systems • communications equipment
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device to maintain the exact specified temperature called for by power lever setting.

Thrust Aids Taxiing

Ground idle and taxi condition take advantage of engine's jet thrust for taxi power while propeller blade angle shifts about full flat pitch, sometimes easing over into the beta or reverse range to maintain the ground idle rpm. at specified 10,000.

Allison has included on Electra power system a sensitive turbine inlet temperature gage capable of fine readings. Replacing the downstream exhaust gas temperature, the turbine inlet temperature reading will give pilots a truer check on power situation, since temperature at this point accurately reflects propulsion efficiency in terms easily read by a busy pilot. In addition, unexpected temperature fluctuations in this area would warn of possible danger situations.

Also for the benefit of pilots, a direct horsepower reading gage will be incorporated on the Electra rather than a BMEP, or torque-meter, with pickoff located between the propeller reduction gear housing and the front of the turbine itself, for an accurate indication of horsepower being delivered by the turbine engine.

Air Start Procedure

Air starts for the 501-D13 are no problem for two-pilot operation. After emergency shutoff handle for fluids at firewall is returned to normal position, with fuel and ignition switches in "off" position, unfeather button is activated until engine starts windmilling up to minimum speed, after which fuel is turned on and engine re-ignited.

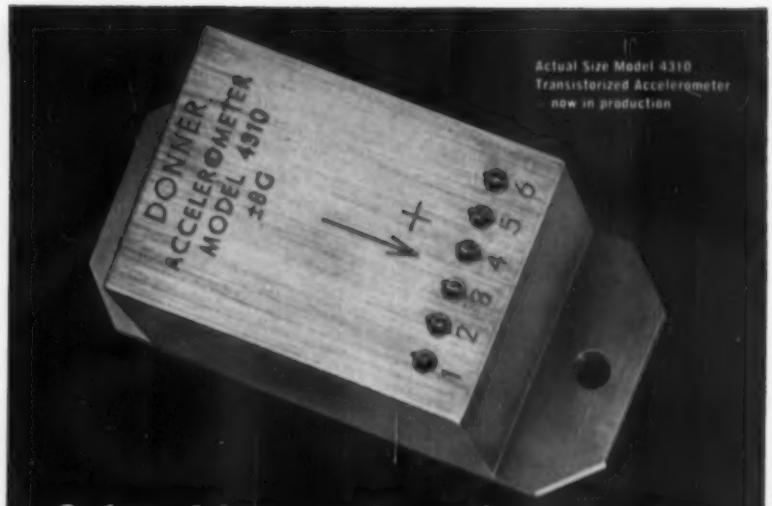
Observations during the flight showed that fuel flows at various power settings at the chosen 9,000 ft. altitude ranged between 1,000 and 1,100 lb./hr. at cruise conditions with a 19C outside air temperature. Range of turbine inlet temperatures was from 500C at flight idle condition to 970C at maximum takeoff power, with majority of flight regimes in the 650C to 800C bracket.

Quick application of maximum continuous power from flight idle position produced a marked acceleration along the flight path, to the extent that a person walking forward in the plane's aisle took two extra steps involuntarily, but did not lose balance.

Noise Inoffensive

Noise factor during wide power changes revolved more about deepening timbre of sound at higher powers, rather than any change in pitch or level of noise.

Lack of vibration was demonstrated with a five-cent piece balanced on a table in ordinary flight, and through



0.1% Linear Accelerometer

COMPLETELY TRANSISTORIZED*

ACCURACY	0.1% of Full Scale
LINEARITY	< 0.05%** Deviation from Best Straight Line
RESOLUTION	Better than 0.0002% of Full Scale
WEIGHT	3.2 Ounces
OUTPUT	±8 v dc for supply voltages of ±15 v dc
POWER REQUIREMENTS	150 milliwatts total input

MODEL 4005

STANDARD DONNER VACUUM TUBE MODELS

MODEL 4112

MODEL 4143

The Donner Model 4310 precision linear servo accelerometer is a sub-miniature counterpart of the standard Donner vacuum tube models which have been giving phenomenal performance for the past 3 years. Requiring only ±15 volts of unregulated dc power at milliwatt levels, the Model 4310 delivers ±8 VOLTS of output at 0.1% accuracy. Zero stability and linearity are enforced by the self-contained high gain servo system. Silicon transistors allow operation from −40° C. to +100° C.

All Donner models (see table below) ruggedized and hermetically sealed, are adaptable to any acceleration measuring problem. They are well suited to airborne applications such as telemetering, navigation, control and guidance systems. In a typical application, the Model 4143 exerts a control function in the inertial stabilization of helicopters.

SPECIFICATIONS	MODEL 4005	MODEL 4112	MODEL 4143	MODEL 4310
ACCURACY	0.1% Full Scale			
RESOLUTION	Better than 0.001%			0.0002%
LINEARITY	0.1%	0.05%	0.1%	0.05%
RANGES	±0.1G to ±20.0G		±0.5G to ±10.0G	±0.05G to ±50.0G
OUTPUT, MAX.	±35 volts	±15 volts	±45 volts	±8 volts
COMPANION POWER SUPPLY	Model 4051 $175.00	Model 4071 $250.00	Model 4071S $250.00	
MAGNETIC SHIELDING	Yes	Yes	No	Yes
NET WEIGHT	1.6 lbs.	1.3 lbs.	0.8 lbs.	0.2 lbs.
PRICE (F.O.B. FACTORY)	$540.00	$800.00	$490.00	$450.00

Write for Data File 210 describing Donner's full line of accelerometers.

Address Dept. 0510

*Silicon MIL-USN transistors used on approved military contract. Fully equivalent components without specific MIL approval supplied for non-military applications.

**Typical measured linearity 0.01%.

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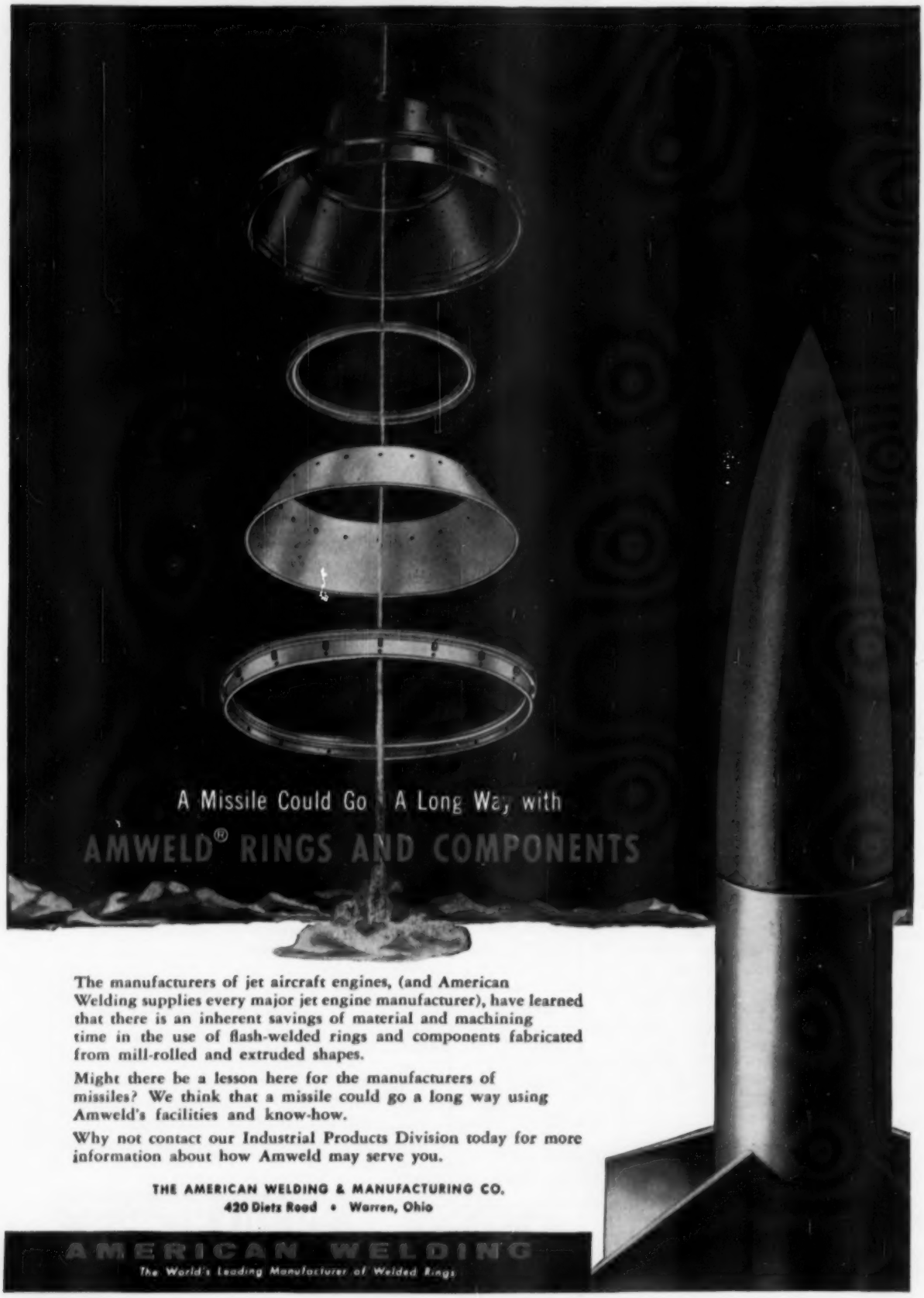

The manufacturers of jet aircraft engines, (and American Welding supplies every major jet engine manufacturer), have learned that there is an inherent savings of material and machining time in the use of flash-welded rings and components fabricated from mill-rolled and extruded shapes.

Might there be a lesson here for the manufacturers of missiles? We think that a missile could go a long way using Amweld's facilities and know-how.

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non-abrupt power changes. Overall impression of mostly uninsulated test bed was one of unusual quietness although propellers are 26 in. closer to fuselage than those of Electra.

Engines installed on test bed were standard production models of 501-D13. To date of this flight, 64.6 hr. had been accumulated with no major engine components showing any signs of wear or needing other than routine attention. Replacements were limited to small items mostly related to the installation on the R7V-2 rather than to the test program itself.

PRODUCTION BRIEFING

Atmosphere Control Co., Inc., Philadelphia, Pa., has established a prototype and manufacturing division which will handle individual and production runs of spinnings up to 92 in. in dia. and up to ½ in. thickness in aluminum, rolled steel and stainless steel as well as brass and bronze.

North American Aviation, Inc., Columbus, Ohio, Div., is completing million-dollar engine test cell. The cell will accommodate any aircraft that can be handled aboard a Forrestal class aircraft carrier. Its 46 ft.-long muffler will reduce the noise level of 50,000 lb. thrust engines to city auto traffic level, according to North American.

Wolverine Tube Division of Calumet & Hecla, Inc., Detroit, Mich., which has been able successfully to extrude molybdenum tubing, can supply 3-6 ft. lengths of less than 1-in. diameter tubing (0.1 wall thickness) for evaluating purposes. The extrusion process, which has been developed in conjunction with the Climax Molybdenum Co., may be applicable for jet engines, and nuclear powerplants. In nuclear powerplants it could be attractive because it will retain its strength and resist corrosion of liquid metals at temperatures over 1,700F, Wolverine said.

Fruehauf Trailer Co. has formed a new research and development engineering department in the company's missile products division to handle its increased guided missile work. The new research and development department will be located in the Grosse Pointe Woods section of Detroit and will be headed by Robert K. Maddock.

Era Engineering Inc., Santa Monica, Calif., says that Douglas Aircraft Co. has given it a contract to develop an instrument for in-flight measurement of material thickness. It will be used for erosion rate studies.

Kaiser Aluminum, Chicago, Ill., says it has placed an order with Hydraulick G.M.B.H. of Duisburg, Germany, for construction of a 30-million-lb. plate stretcher which will possess nearly twice the power of the largest stretcher now in operation in the U.S. Capable of gripping the ends of a 60-ft-long plate of high-strength aluminum alloy and literally lengthening it as much as 5 ft., the stretcher will be installed in Kaiser's Ravenswood, W. Va., rolling mill.

SAC Silver Jubilee Newsreel
BY JACK PATTON
STILL UP FRONT
SPELL JET WITH A G OR J ?
SAC IN LATE '54 BID ON THE AF's FIRST JET ENGINE O'HAUL CONTRACT.
THE WINNAH ..... SOUTHWEST AIRMOTIVE!
WRIGHT FIELD
WE SUCCEEDED IN ONE OF THE BIGGEST STEPS IN PRIVATE AVIATION HISTORY.
WE DID IT!
I'M SLEEPY
AFTER BUT 150 DAYS OF 'ROUND-THE-CLOCK LABOR SACSTERS TESTED ENGINE #1
YOU BOYS'VE NEVER LET US DOWN!
THE JET AGE AT SOUTHWEST NOW IS A BIG AND EFFICIENT REALITY.
FIRST IN THE JET AGE!
Since 1955, America's first and only commercial, non-manufacturing jet engine overhaul facility.
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PIONEER-CENTRAL INTRODUCES NEW FLIGHT INSTRUMENTS FOR JET AGE REQUIREMENTS

VERTICAL VELOCITY INDICATOR

MODEL 1654

Designed to meet the exacting lighting and performance requirements of jet age commercial, military and business aircraft, Pioneer-Central's new Vertical Velocity Indicator features integral lighting and rapid response indications.

Rapid response enables the pilot to quickly establish and maintain uniformly precise rates of ascent and descent during climb-out and let-down—a necessity in today's high-density traffic zones and at the high speeds of modern transport aircraft.

Another new feature—integral lighting—reads white by day and red by night. Red—the color science has proved best suited for "dark-adapted" eyes—provides sharper readability.

Model 1654 complies fully with lighting specification MIL-L-25467A and is CAA approved to TSO-C8a. Units are available in either standard 3" bezel or clamp-on style mountings.

Turn-and-Slip Indicator, Model 3922, is another new member of Pioneer-Central's family of fine instruments. It, too, provides integral lighting for better readability, reading white by day and red by night. Like its companion, at left, it complies fully with lighting specification MIL-L-25467A and is CAA approved to TSO-C3a.

TURN-AND-SLIP INDICATOR

MODEL 3922

Equally important are two additional design features—provision of a power failure indication and reduced weight. Should power fail at any time, the flag shown at "off" position, upper right, instantly informs the pilot the instrument is inoperative. Reduced weight and simplified installation are achieved by the use of a gyro motor design operating from a single-phase 400-cycle AC power source. A similar unit is available with inclined gimbal for installation in tilted panels.

Turn-and-Slip Indicators of various types are available to operate from single- or three-phase AC, DC, or air power sources. Companion instruments are in process of design and production—Airspeed Indicators—Fuel Flowmeter Systems—Breathing Oxygen Equipment.

For complete specifications write Pioneer-Central Division, Bendix Aviation Corporation, Davenport, Iowa. West Coast Office—117 E. Providencia, Burbank, Calif. Export Sales & Service—Bendix International Division, 205 East 42nd St., New York 17, N. Y.

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Precision Producer of Aircraft Instruments, Breathing Oxygen Systems, Fuel Flowmeter Systems, and Ultrasonic Cleaners

GE Seeks to Predict 1972's Weapons

By Philip J. Klass

Santa Barbara, Calif.—General Electric has assembled here a staff of more than 50 top physical and social scientists and engineers to answer a question of vital importance both to the nation and to the company: How can the newest concepts on the technological horizon and the capabilities of one of the country's largest defense electronics manufacturers best be applied to produce the weapon systems needed five to 15 years hence?

General Electric's Technical Military Planning Operation, called Tempo for short, is unique in many respects in the defense industry. Many manufacturers have groups of long-range planners. But none is as large or as comprehensive in scope of activities.

TOP COMMAND of General Electric's Technical Military Planning Operation (Tempo) includes (left to right) T. A. Kvaas, Harry O. Paxson, Peter J. Schenk, Dr. Richard C. Raymond, Tempo manager; Russell L. Krapf, and Roy L. Stewart.

Trend Study

The Technical Military Planning group seeks to evaluate future trends in weapons from a political, economic and psychological as well as from a technological viewpoint. For example, the nation's all-out effort in ballistic missiles could mislead a company into concentrating all its efforts in the same field. A study by General Electric's planners points up certain political disadvantages of the ICBM compared to hypersonic manned bombers. For example, the manned bomber can be launched prior to hostilities but can be recalled short of the target in event of a sudden change in the international scene. This suggests that both manned and pilotless weapons are needed for strategic bombing.

Other studies range from the possible effect of future world population pressures on international relations to the cost of operating an intercontinental ballistic missile base, and from a study of the feasibility of an electrostatic gyroscope to an analysis of the likelihood of future "brush-fire" conflicts and their possible locations.

In the diversity and scope of activities, Technical Military Planning Operation, bears some resemblance to the Rand Corp. Dr. Richard C. Raymond, who heads the GE planning group, came from Rand where he was chief of its electronics department. About one-fourth of the GE planning group's professional staff worked at Rand at one time or another.

But there is a significant difference. Rand is a non-profit organization and has no product engineering-manufacturing operation. Technical Military Planning Operation is part of GE's Defense Electronics division, whose products range from airborne electronic countermeasures to huge ground radars and ballistic missile nose cones. Annual division sales total about $400 million.

One of Technical Military Planning Operation's major roles is to assist its three sister departments: Heavy Military and Light Military Electronic Equipment Departments, and Missile and Ordnance Systems Department. Tempo itself has no laboratory facilities. Its scientists work with paper, pencil, computers, and their minds. When laboratory investigations are required, they are farmed out to sister departments or to GE's Electronics or Research Laboratories.

Outside Customers

About 85% of the current effort is devoted to company projects, the balance to outside customers—including both the military services and aircraft missile prime contractors. The GE group hopes to increase outside-sponsored projects to about half its total effort during the coming year, according to Dr. Raymond.

One representative project, now under consideration, is with a Navy aircraft supplier. It calls for a Technical Military Planning study to recommend the kind of avionic detection and guidance equipment which will be required for anti-submarine warfare in the 1960's. For such a study, the GE planners will use the know-how of its sister departments as well as its own.

Tempo recently submitted a proposal to the Airways Modernization Board for an airport design criteria study which would include such things as runways, lighting and surface traffic control aids.

Outside Sponsors

The reason for seeking outside sponsorship is based on economic necessity. A great diversity of talent is required to explore the many factors which influence the nature of international conflict and weaponry. Physical scientists, with backgrounds in such fields as aeronautics, electronics, geophysics, nucleonics, mathematics and logistics, must be supplemented by social scientists with backgrounds in political science, economics, geopolitics and psychology.

The minimum size staff—or "critical mass," as Dr. Raymond refers to it—needed for an operation like the military planning group is too large even for a giant like General Electric to support on its own, Raymond admits. With the present professional staff of slightly over 50, and a comparable number of supporting personnel, which Dr. Raymond believes is only slightly over

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New, lightweight Westinghouse aircraft transformer withstands severe vibration, shock, humidity

This new Westinghouse aircraft current transformer performs accurately under the most extreme operating conditions — even in ambient temperatures from −55°C to 170°C.

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The new unit has a 250/2-ampere current ratio and operates on 115-volt, three-phase, 400-cycle systems. It fulfills the requirements of specification MIL-T-7210 for Type D-2 current transformers.

For further information about this outstanding aircraft transformer, call your Westinghouse representative . . . or write: Specialty Transformer Department, Westinghouse Electric Corporation, P.O. Box 231, Greenville, Pennsylvania.

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the "critical mass," the planners' annual operating budget is about $1 million.

Funds come from assessments on sister operating departments and outside contracts.

By expanding outside sponsorship, Dr. Raymond hopes to be able to increase the professional staff to about 100 next summer and support further modest growth in subsequent years.

How Group Started

Two years ago, GE formed a group to study its defense electronics business and to recommend organizational changes which would enhance company's position. One of the recommendations was the creation of Technical Military Planning Operation. Another was to split off GE's defense electronics efforts from company's consumer and industrial electronics activities. New Defense Electronics division, under Dr. George L. Haller (who headed study group), was formed in May 1956. The planning group was created shortly afterward.

Two of the significant defense electronics trends pointed up by the study which led to Tempo's formation were:

• **Whirlwind pace of technology** was forcing military to turn to industry for more guidance in determining what could be accomplished in future weapons for the military.

• **Size and complexity** of military electronic systems was growing rapidly. General Electric found that size of its average defense electronics contract had increased by 400-500% between 1946 and 1956.

Need for Planning

This pointed up the need for a broad, long-range planning group, both to guide the company and to assist the military.

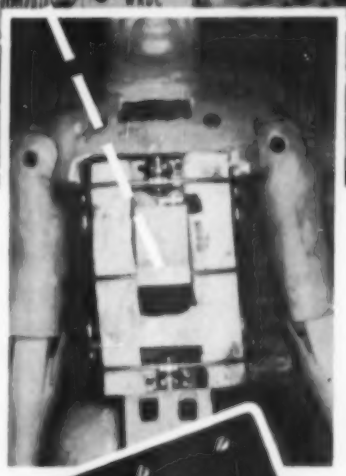
A single bad decision on whether to bid or turn down a large new weapon system program could have a serious impact on GE's future business, according to Peter J. Schenk, marketing manager and a member of the study group.

Each of GE's defense electronics departments has long had its own product planning group, and still retains this function. However, under ground rules of GE's decentralization, each department operates almost like a separate company.

This tends to circumscribe the area of each department's planning in an era when growing weapon system complexity often cuts across two or more departmental lines of authority.

Sometimes this has resulted in overlapping areas of interest where two GE departments competed against one another. It also has created technological "no-man's lands" where the company

DATA from a DUMMY



with an FM TELEMETRY Transmitter

Sensitized for human reactions, this dummy helps collect human factor data for development of ejection seats for supersonic jet aircraft. The full-scale rocket sled tests are one phase of the industry-wide program to develop a safe standardized pilot escape system for the Air Force.

The Model 3021 Transmitter used in these tests is a rugged subminiaturized unit designed for high shock impact and extreme environments.

Frequency	**- 215-235 mc**
Power Output	**- 2 watts**
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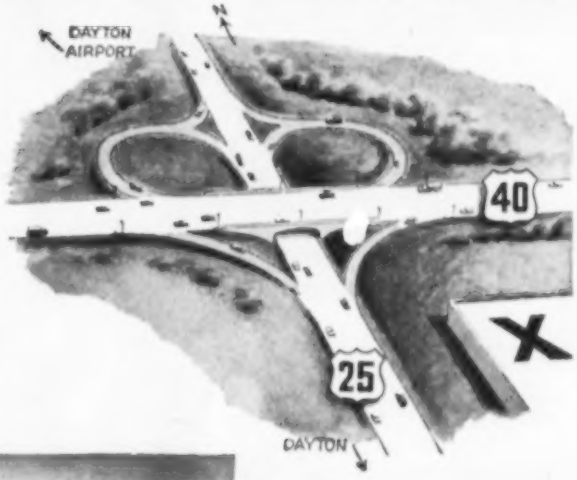

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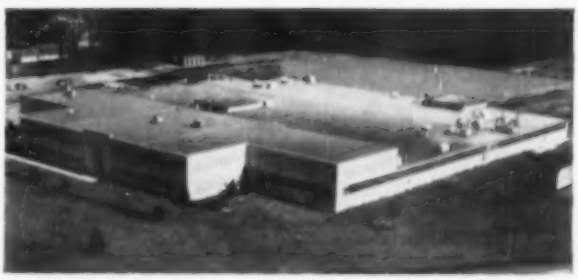

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should have been active but was not because of departmental barriers.

Crossing Barriers

One of Tempo's tasks is to conceive and analyze complex weapon systems which cut across assigned areas of responsibility of more than one operating department.

Related to this is the group's search for technological voids where GE should be active to give it the capability for taking on future weapon system developments.

Still another objective, according to Dr. Raymond, is "to improve GE's batting average" by assisting operating departments in selecting those development programs which appear to hold the best promise of going into production.

For example, the planners might counsel an operating department against bidding on a new weapon development because analysis indicates little likelihood of ultimate production.

However, the final decision rests with the operating department.

Careful Selection

The need for careful program selection is becoming increasingly important as a result of recent Defense Department statements that fewer development programs will be allowed to mature into production, and as a result of the growing engineering investment that goes into new weapon developments. Until government-sponsored development is made a profitable end in itself, a manufacturing company like GE must view its development effort largely as a means to one end—production.

Organizationally, Technical Military Planning Operation is divided into five groups:

• **Environment,** headed by Brig. Gen. Harry O. Paxson (Army, Ret.), seeks to define the environment in which future international conflicts may occur, including geographic, economic and psychological considerations. Physical and social scientists within the group seek to keep abreast of all new technological developments across a broad spectrum of sciences in order to predict how they can or might affect future weapon systems.

• **Synthesis,** under T. A. Kvaas, performs a role which might be compared with preliminary design in an aircraft company, or with systems engineering in an avionics company. The Synthesis group, made up largely of physical scientists and engineers, interprets military operational needs in the light of new technological advances to derive future weapon systems. Preliminary designs are carried to the point where development equipment design can begin if it is decided to develop the weapon system.

• **Evaluation,** under Roy L. Stewart, Jr., critically evaluates weapon systems, usually by means of an operational analysis. Evaluations are made with respect to such factors as the stated operational need, the computed effectiveness of the system and its overall cost. Evaluation group is a mixture of "jaundiced-eyed" mathematicians, economists and operations analysts.

• **Marketing,** under Peter J. Schenk, performs marketing liaison between

Electronic Slide Rule

Small general purpose digital computer designed for engineering laboratory features operating simplicity and choice of automatic positioning of decimal point or fixed point mode of operation. Developed by International Business Machines Corp., new IBM 610 sells for $55,000, rents for $1,150 per month. Typical computation speed is 1.37 sec. for average multiplication, 0.28 sec. for addition or subtraction. Machine has magnetic drum memory, accepts operating instructions on punched tape.

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Model 4301B

• 30 VA OUTPUT

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The Model 4301B is a typical Varo transistor inverter. Other models with higher power output, higher frequency output, and ac input are available for systems engineering. Custom designs can be produced for special applications.

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Output:	*30 V.A. 1Φ*
Frequency:	*400 cps ± 0.1%*
Voltage:	*115 V ±10%*
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Weight:	*2 lb.*

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Motor				
Fixed Phase Voltage	26v	115v	115v	26v
Control Phase Voltage	26v	115v	115v	26v
Frequency	400	400	400	400
Max. Power @ Stall	6	5	5	6
No Load Speed	10,500	10,000	10,000	10,500
Generator				
Excitation Voltage Phase 1	26v			26v
Output Phase 2	0.3v/1000 RPM 100,000 ohm load			0.3v/1000 RPM 100,000 ohm load
Null	.012v			.012v
Wobble Voltage	.007v			.007v
(Power Excitation)	3.5 watts Max.			3.5 watts Max.
Linearity	0.5% to 4000 RPM			0.5% to 4000 RPM
Potentiometer				
Mechanical Rotation	• 360°	360°	360°	360°
Resistance	1000 ohms	50,000 ohms	50,000 ohms	1000 ohms
Accuracy of Total Resistance	±5%	±5%	±5%	±5%
Electrical Angle	350°	350°	350°	350°
Servo Block Unit				
Ambient Temperature	−55°C to 72°C	−55°C to 72°C	−55°C to 72°C	−55°C to 72°C
Altitude	−1000 feet to 55,000 feet	−1000 feet to 55,000 feet	−1000 feet to 55,000 feet	−1000 feet to 55,000 feet
Life	3000 hours excluding pot.	3000 hours excluding pot.	3000 hours excluding pot.	3000 hours excluding pot.
Gear Train				
Ratio	1000 : 1	336 : 1	167 : 1	10,000 : 1
Dust Enclosed per	Section 4.11 MIL-E-5272A	Section 4.11 MIL-E-5272A	Section 4.11 MIL-E-5272A	Section 4.11 MIL-E-5272A
Backlash	Anti-Backlash gear on pot.	1°	1°	Anti-Backlash gear on pot.
Synchro				
Input Voltage—Stator	11.8v			
Output Voltage—Rotor	10.6v			
Clutch Brake				
Input Voltage		100v dc	100v dc	
Input Power		2.0 watts Max.	2.0 watts Max.	
Operate Time—Energize		5 milliseconds	5 milliseconds	
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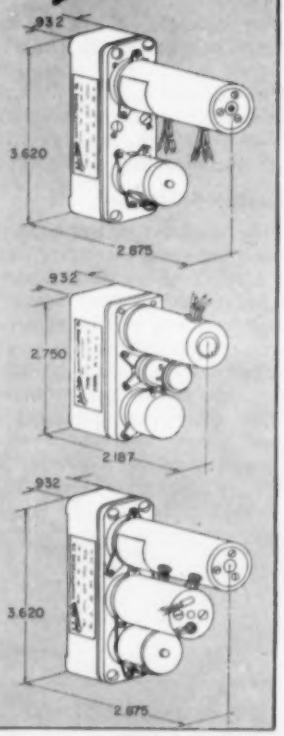

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planners and customers. These customers may be other GE departments, military prime contractors, the military services or other government agencies. Schenk views his group as a sort of catalyst to bring about a GE reaction to a customer's needs in complex systems.

• **Finance & Administration,** headed by Russel L. Krapf, provides and maintains facilities and services to support the staff.

Project Operation

Individual programs are carried out on a project basis, each with its own project manager. The latter may come from Environment, Synthesis, Evaluation or Marketing group. Each project may have between two and 25 scientists working full or part time with scientists drawn as needed from one of the four major "skill pools."

At present there are about 20 projects underway.

Technical Military Planning Operation seeks men who are both specialists and broad-gaged in their experience and interests.

One of the staff members, for instance, is an aeronautical engineer with aircraft design experience at Douglas and Lockheed, who subsequently turned economist.

Another holds an M.S. in physics, a Ph.D. in statistics. Still another is an expert on Soviet Russia's national economy, has military intelligence and aircraft industry experience.

A number of staff members are hard-headed engineers with many years of industrial experience to back up their judgment.

Ethereal Business

Crystal-ball gazing is a tenuous and ethereal business at best. This is particularly true when the gaze is directed five to 15 years hence and is attempting to assess the interplay of future developments in technology, international relations and weaponry. It would be no mean accomplishment to score a modest batting average in predicting the course of any one of these factors for the next five years, let alone to assess the combined effects of all of these factors 15 years hence.

Schenk believes that at best, perhaps, Technical Military Planning Operation can only provide "a clear, but erroneous, picture of the future." Yet, in the fast-moving, fast-changing defense electronics business, this may prove a big advantage over no picture at all.

Based on the first year's operation, Dr. Raymond believes that the planners will give General Electric a "better feel" for the direction in which both weapon system development and national policy are likely to go.

Expansions, Changes In Avionics Industry

Textron, Inc., has acquired all the assets of California Technical Industries (formerly Color Television Inc.) of Belmont, Calif., producer of automatic test equipment. New acquisition is neighbor of Dalmo Victor, another Textron subsidiary.

Other recently announced expansions and changes in the avionics industry include:

• **Magnetic Controls Co.,** Minneapolis, has opened new 20,000 sq. ft. engineering and manufacturing facility. Company, which was formed in 1953 to produce magnetic amplifiers and controls, expects to gross $2 million this year.

• **Ralph S. Thacker Co., Inc.,** is name of new company which has purchased principal assets of the Ralph S. Thacker Co., producer of custom electrical connectors and components. Firm's address is 1918 Burbank Blvd., Burbank, Calif.

• **Topp Manufacturing Co.,** division of Topp Industries, Inc., has established new Communications division. Division, which recently received $1 million Civil Aeronautics Administration

The Model FC-3500 is the first tank filler cap to successfully pass all test requirements of MIL-C-7244B (ASG) applicable to fuel, oil, alcohol-water and hydraulic reservoirs.
Lever action design permits cap to be opened safely under pressure and removed completely with only a 35° turn. Now available in 1.5, 2, 3, and 3.82" openings.

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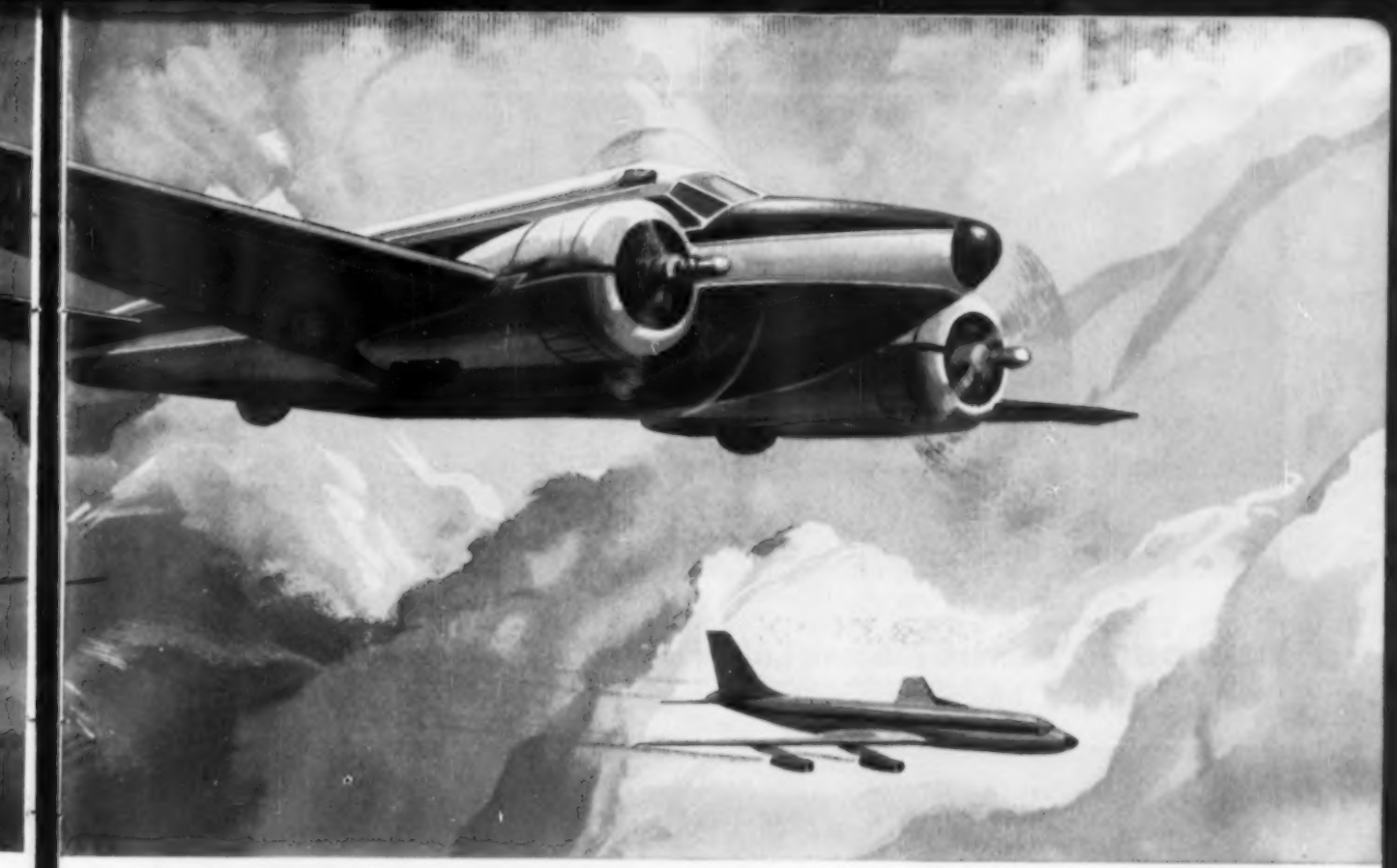
Performance equals that of present commercial airline type weather radar systems requiring twice the amount of electronic rack space. The total system weight is now approximately 85 pounds. What's more, the *new* components are interchangeable with Bendix' famed, time-tested veteran of the global airways, the RDR-1B X-Band System. The built-in flexibility and versatility of newly-designed components make it possible to "customize" Bendix Weather Radar

RDR-1D Transmitter-Receiver
SYN-1B Synchronizer-Power Supply

New RDR-1D Transmitter-Receiver weighs only 26 pounds . . . Synchronizer-Power Supply only 21 pounds. Total rack space for complete system is only 1-ATR.



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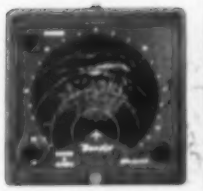

FOR TERRAIN AVOIDANCE: A means for detecting high terrain in flight path is an additional feature of Bendix Weather Radar. This is particularly valuable under emergency conditions due to instrument failure, or when off course. Indicator at left shows mountain ridges in flight path, gives pilot ample time to take avoidance action.

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to fit practically any type of aircraft on the market.

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In addition to its primary function, this new RDR-1D weather radar matches its famous counterpart for ground mapping and terrain avoidance.

For complete information and performance data, write to Bendix Radio Division, Aviation Electronic Products, Baltimore 4, Maryland. Or West Coast—10500 Magnolia Blvd., N. Hollywood, Calif.; Export—Bendix International Division, 205 E. 42nd St., New York 17, N.Y. Canada—Computing Devices of Canada Limited, P.O. Box 508, Ottawa 4, Ontario.

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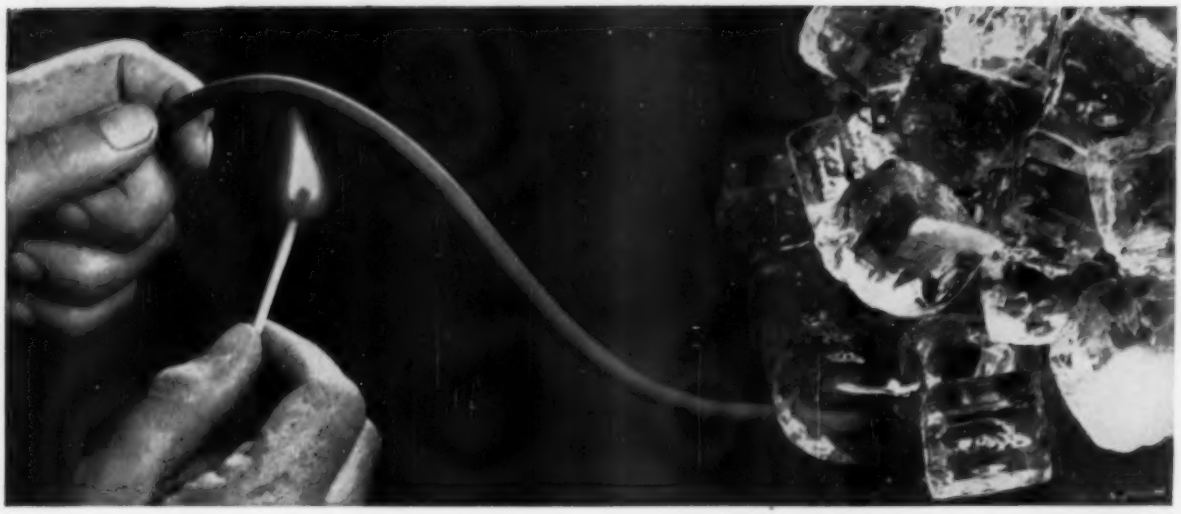

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Flexible, easily handled Packard high-tension silicone-insulated cables are designed and manufactured to give peak performance in extreme temperature variations. Made with either copper or stainless steel core insulated with new Packard silicone compounds, these cables have a safe operating temperature range of minus 65°F. up to 450°F.

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contract to build omnirange station equipment, expects also to design and manufacture airborne communication and navigation equipment.

• **Collins Radio Co.,** Cedar Rapids, Iowa, has reorganized and enlarged its aviation dealer organization. New organization authorizes 23 factory dealers to sell direct, 13 of these also serving as distributors to 77 additional dealers. Total dealer/distributor organization now numbers 113 companies compared to 25 previously.

FILTER CENTER

▶ **Doppler Navigator vs. DME-T**—Air Transport Association is studying possibility of domestic airline use of Doppler auto-navigators, including dead-reckoning computer, instead of distance measuring equipment portion of Vortac (DME-T). ATA's analysis will consider technical, operational and economic factors.

▶ **AN/GSN-5—AN/FPN-34 Wedding?**—New production prototype version of GSN-5 automatic landing system, being designed by Bell Aircraft, is intended to mate with new FPN-34 long-range terminal area surveillance radar being developed by Bendix Radio. Objective is to provide fully automatic control of aircraft from 200 mi. out to touchdown. Both programs are sponsored by Rome Air Development Center.

▶ **Instrument Approaches Increasing**—Number of instrument approaches made between July 1, 1956, and June 30, 1957, jumped 47% over previous year, while number of fix postings made by air route traffic control centers reached nearly 28 million, a 22% increase over previous year, James T. Pyle, Civil Aeronautics Administrator, told recent meeting of Radio Technical Commission for Aeronautics. Pyle said CAA spent $75 million in last fiscal year for traffic control facilities and equipment, expects to spend more than $150 million this year.

▶ **Traffic Control Symposium**—"The Airways Modernization Board: Mission and Methods" will be the subject of a three-day traffic control symposium, Dec. 16-18, to be held in Philadelphia. Speakers will include Elwood R. Quesada, AMB chairman, members of AMB staff, spokesmen for Defense and Commerce Departments, and civil airspace users. Symposium is sponsored by Franklin Institute. For details, write Air Traffic Symposium, Franklin Institute Laboratories, 20th & Parkway, Philadelphia 3, Pa.

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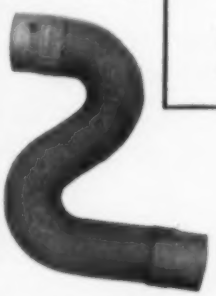
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Radome Anti-icing Duct Pressure Seal Boot

Generator Cooling Duct

Flexflyte is an exceptionally lightweight ducting that is highly resistant to abrasion, vibration and flame and impervious to temperatures from minus 120°F. to plus 650°F. It will handle internal working pressures up to 70 psi and external working pressures up to 15 psig depending on type. Designed for use with ventilating, defrosting and de-icing systems, Flexflyte will take tight turns at any point up to 180° without buckling. No elbows or special fittings are required for installation.

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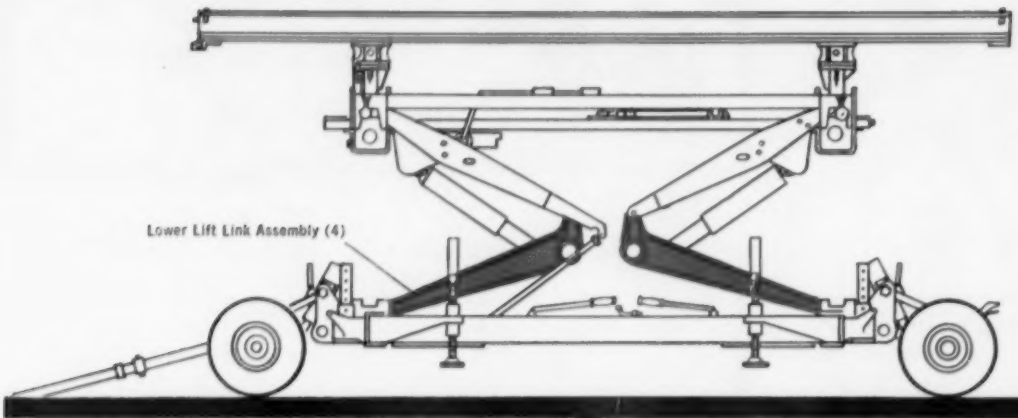
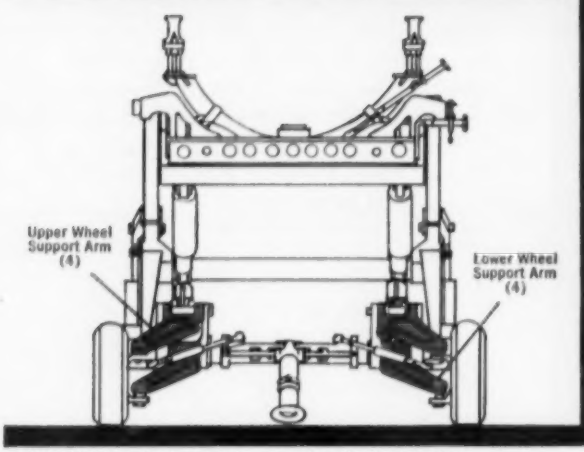




Kaiser Aluminum forgings are shown in red on the drawings above.

ALUMINUM FORGINGS SAVE UP TO 50% IN COSTS — 50% IN WEIGHT

As determined by Air Logistics Corporation cost analysis, the forged aluminum wheel support arms shown above returned a 50% cost saving, as compared to steel weldments. The lower lift arms returned a 10% cost saving.

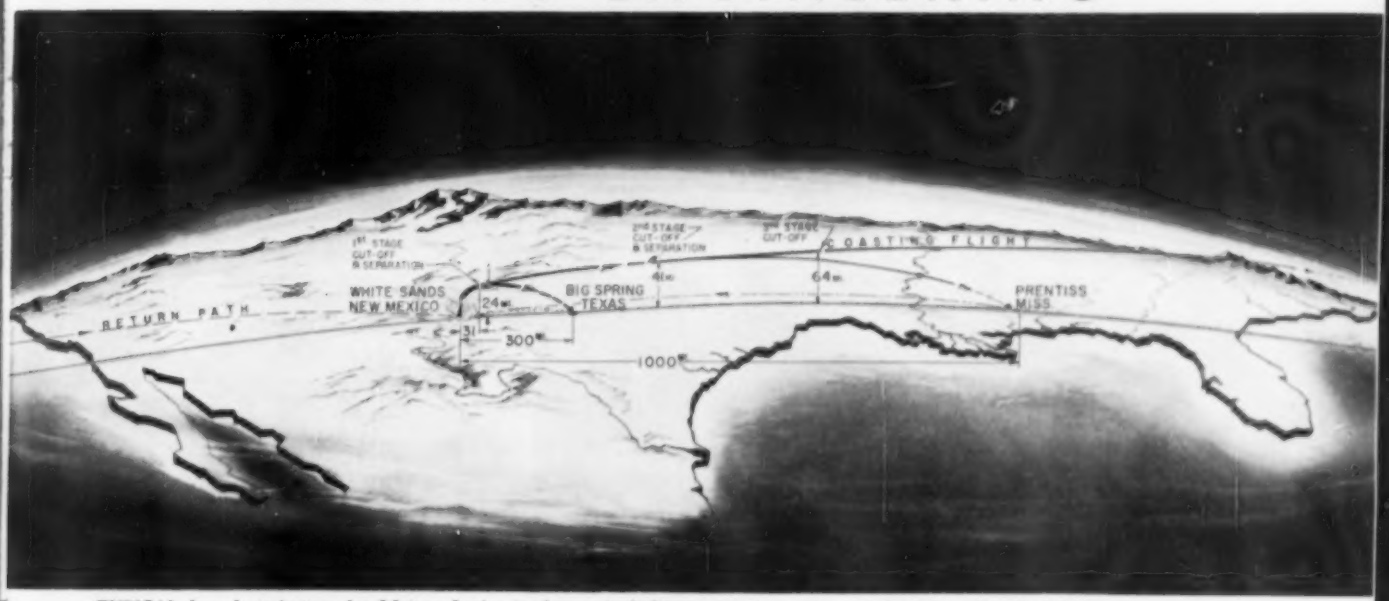
These same aluminum forgings also made possible the following savings in weight as compared to steel: Wheel support arms—50% weight saving; lower lift arms—40% weight saving. Yet the trailer shown is strong enough to handle loads up to 8000 pounds.

And, as additional advantages, the aluminum forgings provided superior springing action and added pleasing appearance to the trailer.

Next time you're faced with a design problem involving costly and complex parts machining and assembly, consider the inherent advantages of single aluminum forgings.

For complete information contact the Kaiser Aluminum sales office listed in your telephone directory. Kaiser Aluminum & Chemical Sales, Inc., General Sales Office, Palmolive Building, Chicago 11, Illinois; Executive Office, Kaiser Building, Oakland 12, California.

THE BRIGHT STAR OF METALS KAISER Aluminum



TYPICAL launch trajectory for Meteor Junior is shown, including separation points of first, second and third stages.

Goodyear Proposes Smaller Space Station

Barcelona—Small inhabited earth satellites which could be launched by ICBM-size missiles were proposed here last week by the Goodyear Aircraft Corp.

The two to four place vehicles are intended to be the most economical means of carrying men over the gap between the X-15 research aircraft and satellite performance.

The Goodyear study is named Meteor Junior and is part of a program to take full advantage of all weight sent into space by using the transport rockets as structural parts of a space station.

Previous Criticism

Meteor Junior was presented to the Eighth Annual Congress of the International Astronautical Federation apparently in reply to technical criticisms of a Goodyear paper given last year before the Seventh Congress. This earlier presentation of a Meteor proposal concerned 20,000,000 lb. rockets and space stations for thousands of people and drew comment as being an overextrapolation of existing technology.

Both of these papers were written by Darrell C. Romick, Richard E. Knight and Samuel Black.

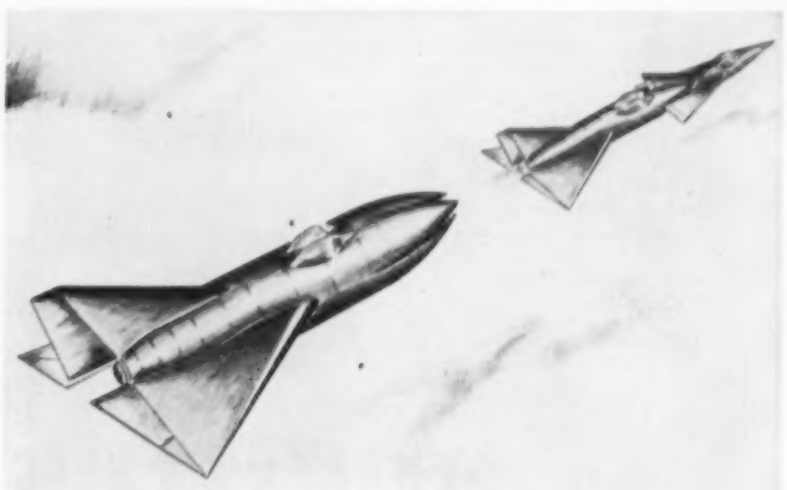
Meteor Junior project as outlined this year proposed launching three-stage rockets weighing from 200,000 to 1,000,000 lb. and building space stations for a few score people at most. Meteor Junior does not have the load-carrying efficiency of the larger more ambitious rockets, but in the eyes of its designers it requires no more technical information than will be available in 1962.

Data Sources

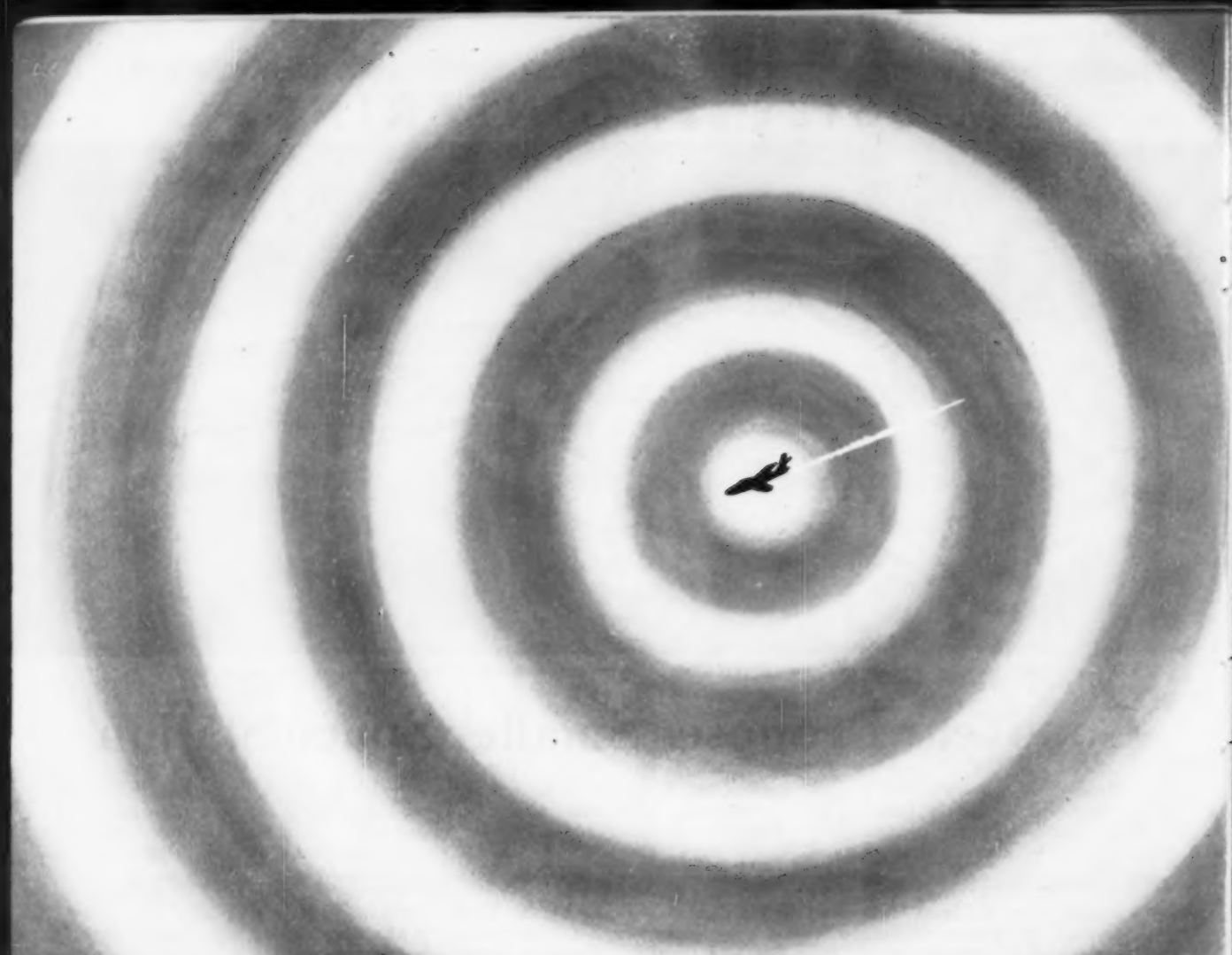
This new knowledge which is to make space flight possible for humans would be provided by such active projects as the X-15, Atlas and Vanguard. Generally the key information they are to furnish concerns:

- **Aerodynamic drag,** heating and reentry effects at very high speeds.
- **Atmospheric ionization,** dissociation and other phenomenon which affect communication and vehicle behavior at very high altitudes.
- **Stability and control** of vehicles beyond the usable atmosphere.
- **Man's reaction** to flight beyond the usable atmosphere.
- **Development** of large rocket motors to operational status.

If these projects are allowed to con-



BOOSTER I separates from the smaller but similarly constructed second stage. Aft end of body has supports for mounting in nose of first stage separation catapult reaction point and piston. When separation from third stage occurs, vehicle is traveling 15,000 mph.



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METEOR JUNIOR ferry vehicle approaches moon (top right), prepares to leave moon (below).

tinue to completion and space flight proves feasible, the main advantage of pursuing the Meteor Junior approach would be economy. Its important features are essentially no different from other older ideas, but the size of its vehicles are smaller than most of those that have been suggested by space flight enthusiasts.

Development of Meteor Junior would begin with the third stage. Crew training with simulators would begin almost as soon as the design of the vehicle. The crew would perform all preliminary flight tests of the third stage as well as ride it into an orbit and later bring it back to earth.

Modified ICBMs

The first and second stages of Meteor Junior would initially be modified ICBM missiles. These would be capable of placing a light third stage carrying two men into an orbit.

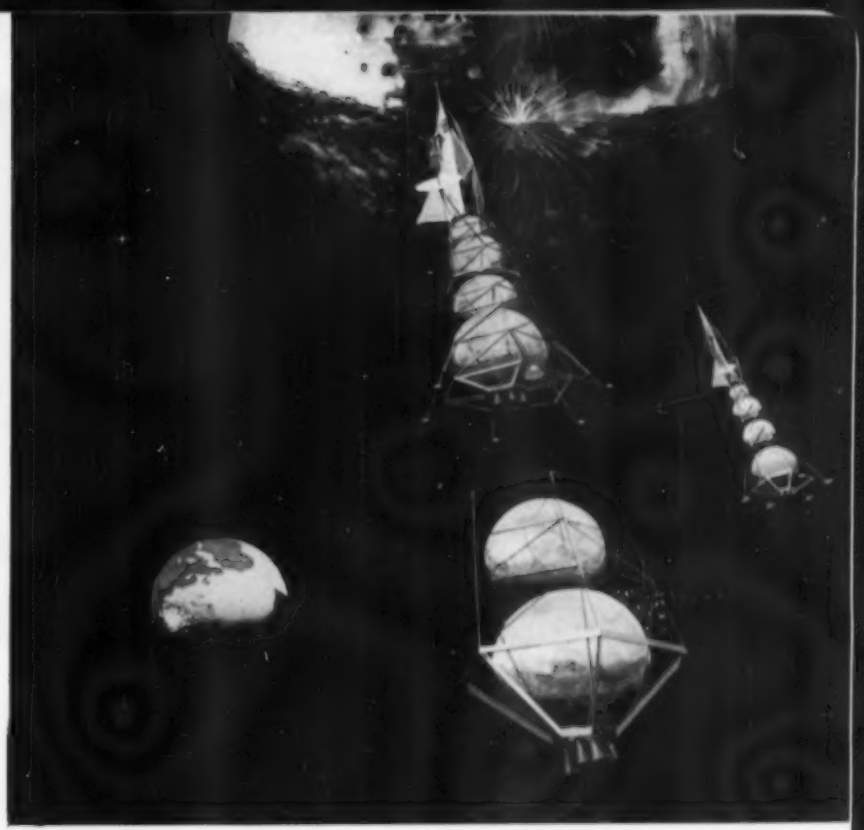
Later the size of the first two stages would be increased and they would have wings and a crew added. They would then be able to launch a much heavier third stage carrying up to four men and a ton of cargo. Once these stages had burned out the crew would glide them back to earth and they could be reused. Jet engines in pods would be attached to each stage after the return to earth and they could be flown from the landing area back to the take-off site. This would cut the number of booster units to maintain any given flight schedule.

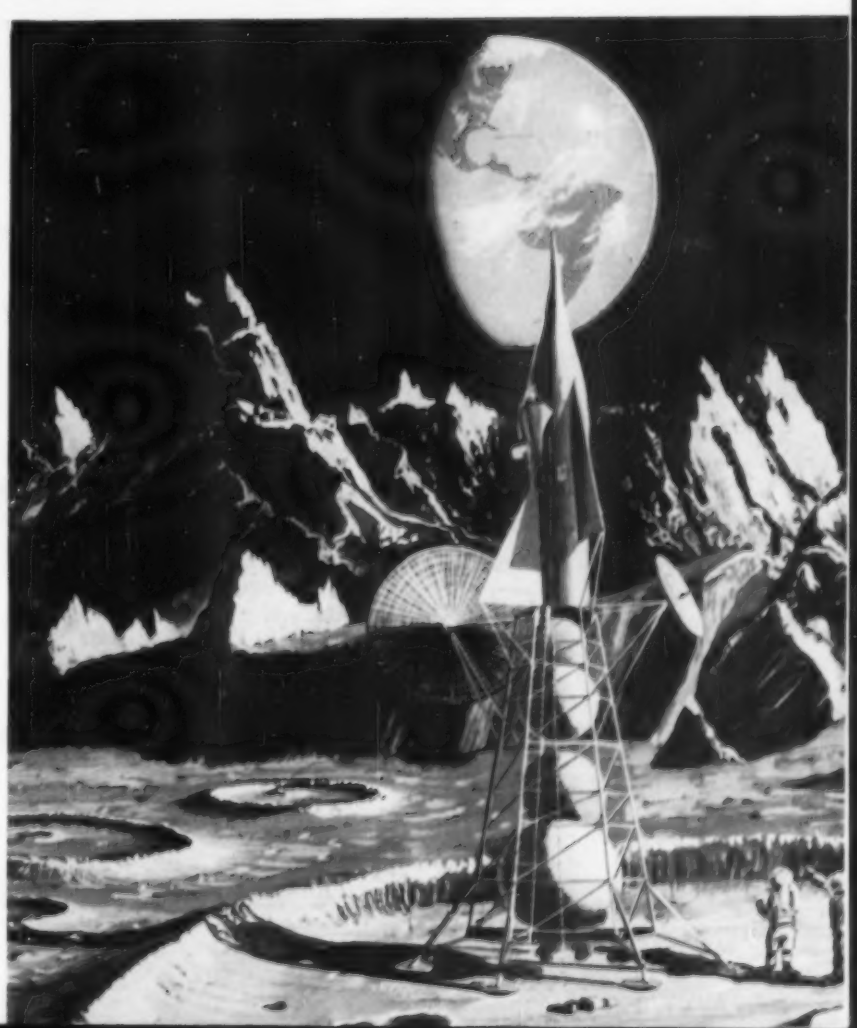
This type of retrievable booster arrangement plus the heavier payload of the third stage is considered necessary for the economical construction of a small, manned space station. Such construction in space would require many freight flights into the orbit. As each booster would cost several million dollars the price would soon become prohibitive if they were only used once. Fuel cost would be $100,000 for the reusable booster stages of each flight.

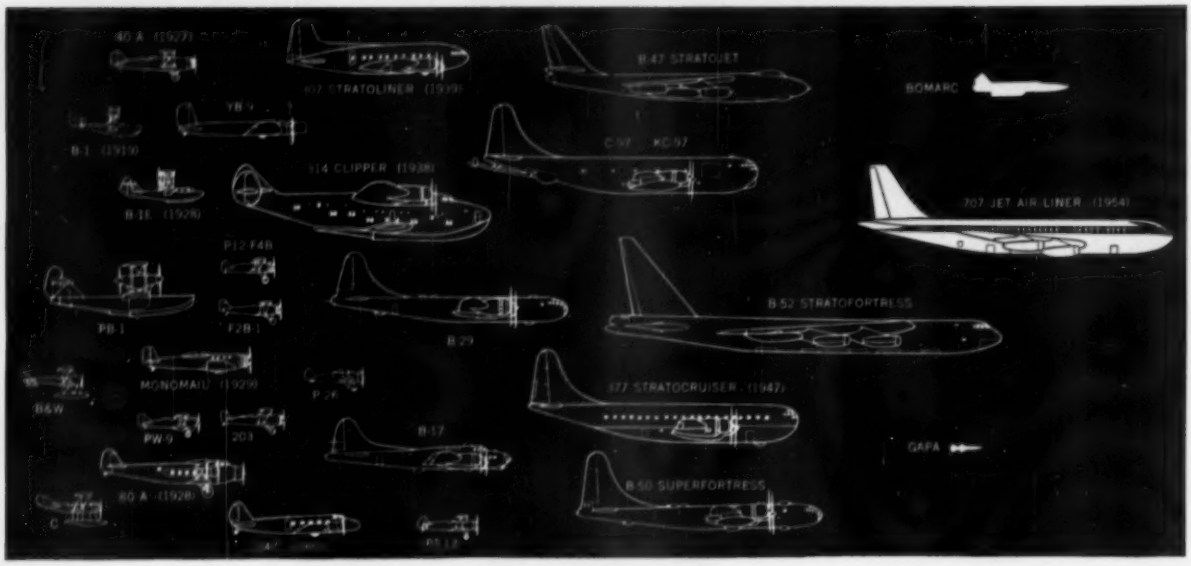
Ground to Cover

The efficiency and size of the powerplants specified for this three stage, winged-booster Meteor Junior gives some idea of the ground that has to be covered in rocketry if the prediction is true that manned space flight will be possible in 1962. The Goodyear study calls for using liquid fluorine as an oxidizer and obtaining an actual specific impulse at sea level of 275 sec. This is well beyond today's capability.

The total thrust of the 27 engines needed to propel Meteor Junior into a 500 mi. orbit is 2,514,000 lb. The en-







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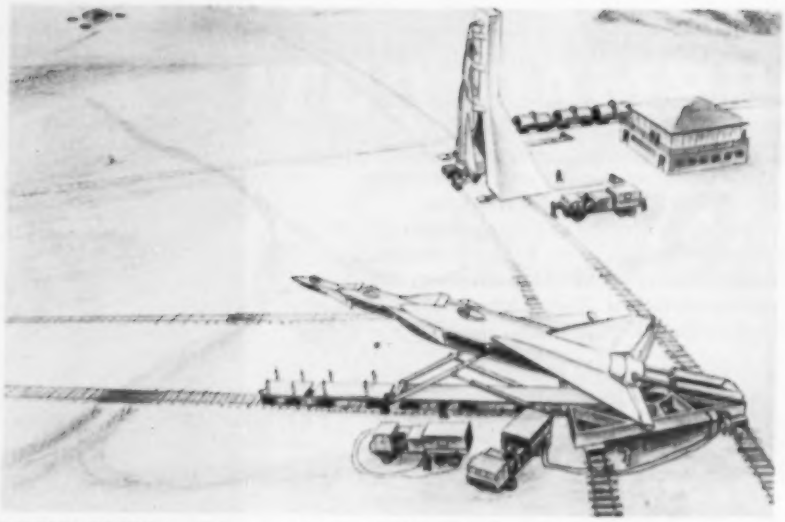
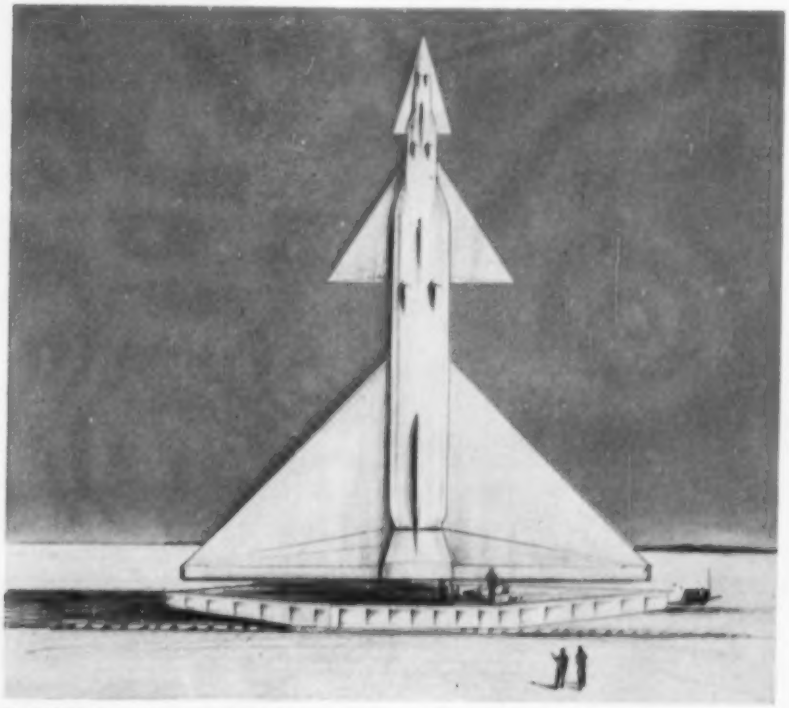


METEOR JUNIOR could be assembled horizontally and then raised by tilting for launch.



PLANFORM of three stages of Meteor Junior vehicle is shown in drawing.

gines are distributed as follows:

- **1st Stage**—17 engines of 130,000 lb. thrust each
- **2nd Stage**—6 engines of 44,000 lb. thrust each
- **3rd Stage**—4 engines of 5,000 lb. thrust each

Some of the motors would be gimbaled so they can be used to provide control of the vehicle.

In the light of current experience the synchronization and engine control problem presented by this array of powerplants would seem formidable even five years from now.

After the third stages of Meteor Junior are placed in orbit they would be modified to become space vehicles for traveling to the moon, rescue vehicles and vehicles for returning personnel and equipment to earth. They would also serve for building blocks in space station construction.

Two types of moon trips are visualized by the Goodyear group, one an exploratory flight around the moon and

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Left to right: S. S. Edwards, flight dynamics; B. W. Marsh, aerodynamics; M. Tucker, Aerothermodynamics Department manager; and R. L. Nelson, project aerodynamics, discuss reentry dynamics.

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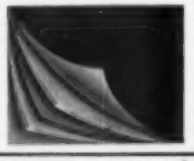

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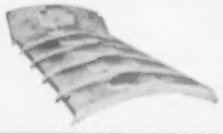

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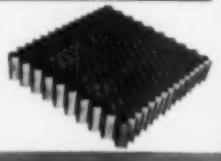

certain each unit meets all phases of the customer's specifications.

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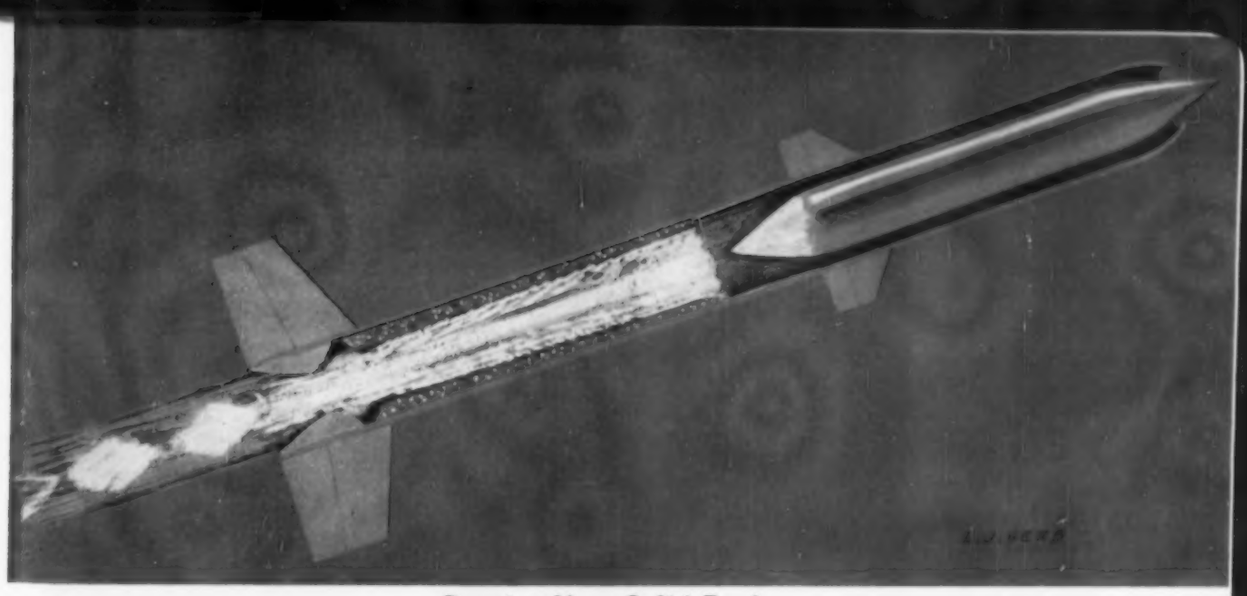
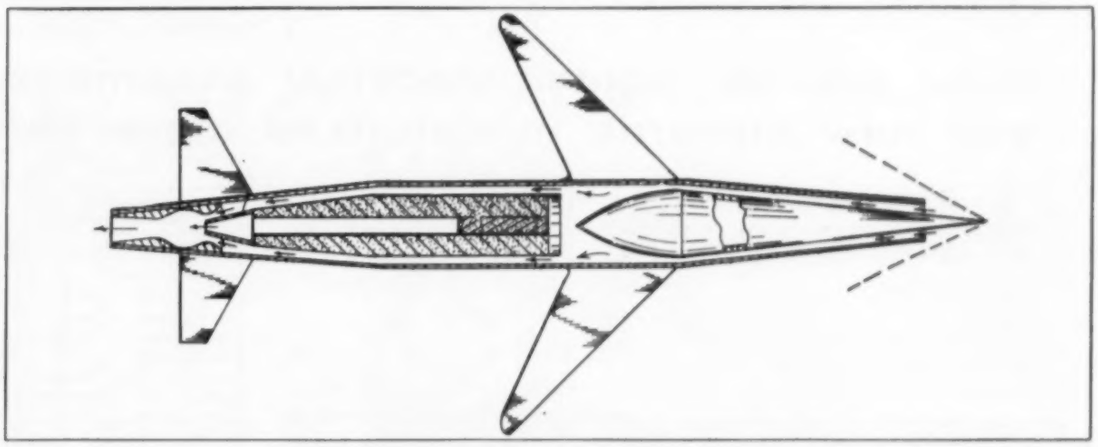


Ramjet Uses Solid Fuel

Solid fuel ramjet which has been under development by Continental Aviation & Engineering Corp., Detroit, Mich. (above), is designed to combine the range of an air-breathing powerplant with the reliability of a solid propellant rocket. This form of a ram-rocket uses ¼ the fuel that a pure solid rocket would use for the same range because ram air is used to make up for oxidizer deficiency. Because some oxidizer is incorporated in the solid fuel lining of the combustion chamber, the ram-rocket is said to be capable of operating at higher altitudes than conventional ramjets. Below, U. S. patent 2,799,987 shows another solid propellant ramjet developed by inventor, Edward F. Chandler, Brooklyn, N. Y.



back to earth and the other a landing on the moon and return. The first type would require only one booster stage in addition to the Meteor Junior third stage already in the orbit. The second type of trip calling for a landing on the moon calls for three additional boosters, making a total of four stages. This moon landing craft would weigh 343,000 lb. (including fuel). A fleet of three would be used for the trip as a safety measure. The crew from any disabled craft could be taken aboard the remaining two.

Goodyear estimates that the initial cost of this 1,000,000 odd pounds of moon rocket fleet plus the cost of ferrying it into the space station orbit so it could be assembled would be slightly over $30 million. This of course does not include any of the development cost of the Meteor Junior equipment. The cost of Vanguard Project to date, for instance, is in the neighborhood of $100 million.

A special nose would be fitted to the third stage of Meteor Junior so that it could function as a pusher-type rescue vehicle. Such duties would be necessary around the space station when a freight or passenger rocket coming up from earth would not reach the precise velocity of the space station and would enter another orbit. This vehicle would enter the orbit of the stranded rocket and bring it to the space platform.

3 Tower Facilities Companies in Merger

Dallas—National Electronics Facilities, Inc. has been formed here to provide complete electronics tower services. New firm is a consolidation of three tower contractors under the leadership of President William M. Taylor.

Tower Contracting Co., Taylor Maintenance Co. and Atlas Manufacturing Co. have joined forces as National Electronics Facilities to provide engineering, design, construction and maintenance of radio, microwave and radar towers and various associated facilities.

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.5	½	1¼
1.0	5/8	1¼
3.0	⅞	1⅛
4.0	1	1⅛
5.0	1 1/16	1⅛
6.0	1¼	1⅛
7.0	1 5/16	1⅛
8.0	1 3/4	1⅛
9.0	1⅛	1⅛
.25	3/8	3/8
.4	½	3/8
.75	5/8	3/8
1.5	1	3/8
18.0	1¾	2¼

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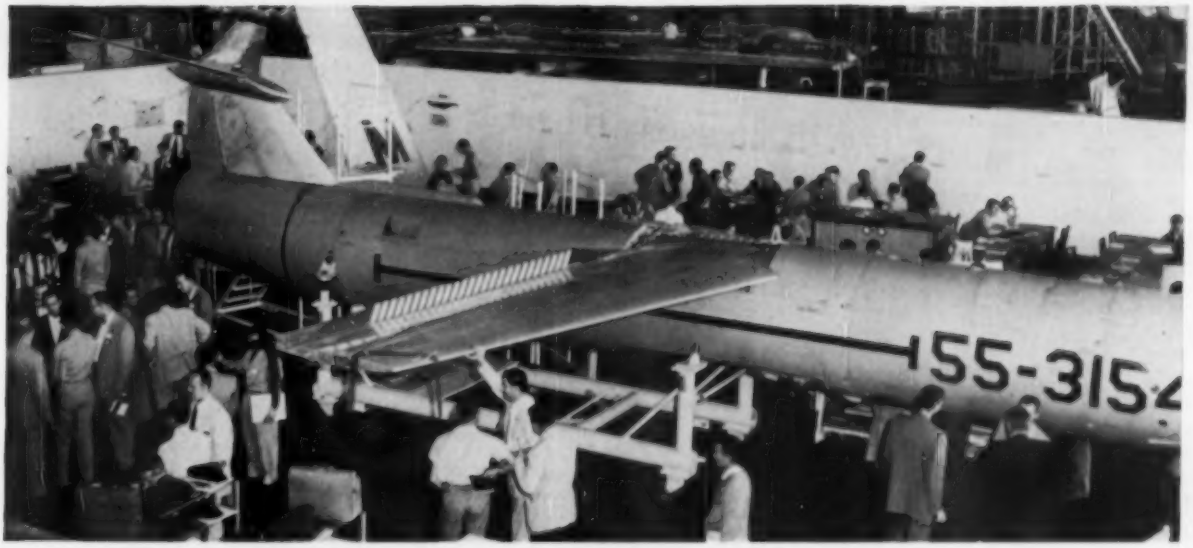


Air Force Inspects Matador Weapon System

Air Force Development Engineering Inspection team examines the Martin Co.'s integrated missile system, built around the TM-76 Matador, in Baltimore. In addition to the missile, system includes launcher, prime mover, test equipment and ground handling equipment designed specifically for new missile, formerly called TM-61B. Martin also determines skill level required of airman operators. New Matador, 44 ft. long with 22.9-ft. wingspan, is scheduled for early 1958 production.

USAF Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by U.S. Air Force contracting offices:

DAYTON AFD, USAF, Gentile AFS, Dayton, Ohio.

Hoffman Laboratories Inc., Los Angeles, spare parts for beacon simulators, contractors model SKS-103, PR-538699, $71,554.

General Electric Co., Owensboro, Ky., tubes, electron, type MIL-6100/6C4WA in a/w Spec. MIL-E-1C, dated 10/3/55—supplemental 1J dated 11/30/56 and ISS MIL-E-1/242A, dated 10/26/54, 50,000 ea.; tube, electron, type MIL-5670 WA in a/w Spec. MIL-E-1C, dated 10/3/55, supplemental dated 11/30/56 and ISS-MIL-E-1/247, dated 5/20/53, 35,000 ea., IFB 33-604-58-28, $134,800.

Westinghouse Electric Corp., Dayton, circuit breaker, thermal magnetic, Westinghouse Electric S. O.-6E5209, application: PP-490/FRT-5, style 1740052, 125 ea., IFB 33-604-57-559, $35,089.

General Electric Co., Clyde, N. Y., 1M135 rectifiers, germanium in a a/w spec. MIL-T-25380/2 (USAF), dated 5/7/56 and all specification or slant sheets, PR: MD-8-5960-30142, $93,600.

Lewyt Manufacturing Corp., Long Island City, N. Y., maintenance spare parts for test set radar sig. gen. AN/UPM-10/U in a/w Navy specification NR SHIPS-T-1661, dated 7/27/54, PR: MD-7-17-80601, $91,000.

SAN ANTONIO AMA, Kelly AFB, Tex.

Airtron Inc., Linden, N. J., aircraft ignition equipment, PR: SA-728593 and SA-728593-1, $46,104.

Minneapolis-Honeywell Regulator Co., Minneapolis, aircraft accessory spare parts, 32 items, PR: SA-729309, $106,562.

Co-Operative Industries Inc., Chester, N. J., aircraft ignition equipment, PR: SA-728593 and SA-728593-1, $37,205.

TOPEKA AFD, Topeka AFS, Topeka, Kan.

Carbide and Chemicals Division, Union Carbide and Carbon Co., New York, N. Y., methanol, (IFB 14-604-57-717), 288,000 gals., $119,795.

Boeing Airplane Co., Seattle, Wash., compass, (open contract, AF 34(601)2842), 25 ea., $70,887.

Marman Division, Aeroquip Corp., Los Angeles, clamp, (RFP 14-604-57-5785), 2,200 ea., $97,900.

Lycoming Division, Avco Manufacturing Co., Williamsport, Pa., holding fixture, (RFP 14604-57-5835), 270 ea. of fixture and 134 ea. of stand, $44,411.

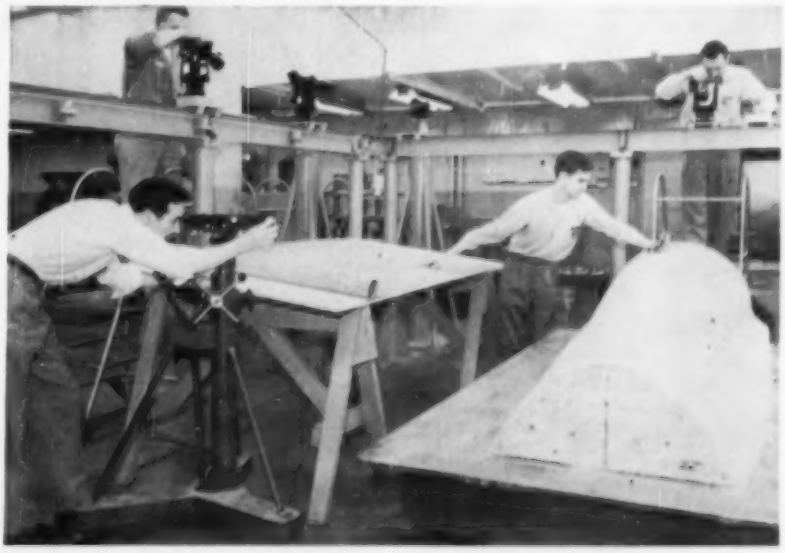
MOBILE AMA, Brookley AFB, Ala.

General Mills Inc., Minneapolis, modification of 85 ea. 66CT balloons and 85 ea 128TT balloons and spare parts, AF 01 (601) 20386, $447,307.

OKLAHOMA CITY AMA, Tinker AFB.

Thompson Products Inc., Cleveland, overhaul of turbo-alternator drive, P/N 4839-TD96200, (Series) P. R. OC-7-031-B52-MC2284), $2,049,630.

A&S Machine Co. Inc., N. Tarrytown, N. Y., clamp assembly, 1AFB-1560-232-



K & E Manufacturing Aids

Tooling check by Columbus, O., division of North American Aviation illustrates how two Keuffel & Esser Co. products aid airframe manufacturing. In optical tooling dock, K & E jig transits and levels are used to check the contour of plaster model (right) and determine the trim lines against the original layout on K & E Stabilene film (Dupont polyester base Mylar) on the table, center. The transparent Stabilene layout, which according to K & E is more dimensionally stable and cheaper than glass-reinforced sheets, was used to print station outlines on metal templates used in the plaster mock-up.

0049, 11,158 ea., (IFB PR OC-726073 and OC-726068), $52,806.

Mustang Sheet Metal & Manufacturing Co., Dallas, clamp assembly, 1AFB-1560-193-4687, 3,170 ea., bolt, 1AFB-60012, 9,401 ea., (IFB PR OC-726073 and OC-726068), $30,876.

AIR FORCE MISSILE TEST CENTER, ARDC, Patrick AFB, Fla.

Radiation Inc., Melbourne, Fla., 10 ea., monitor mixer, model TLM-35, (PR 58-1054), $56,000.

ROME AFD, Griffiss AFB, N. Y.

Hazeltine Corp., Little Neck, N. Y., AN/UPA-35, indicator group with spares used with radar sets, (RFQ 30-635-57-4416Q), 38 ea., $456,000.

MEMPHIS AFD, Mallory AFS, Memphis, Tenn.

Wright Aeronautical Division, Curtiss-Wright Corp., Woodridge, N. J., bearings, AF40 (604)-7763, $20,934.

Sikorsky Aircraft Division, United Aircraft Corp., Stratford, Conn., bearings, AF 40(604)-7747, $189,165.

SACRAMENTO AMA, McClellan AFB, McClellan, Calif.

Lockheed Aircraft Corp., Burbank, Calif., manufacture and prototype installation of electronic equipment kits in one (1) RC-121D type aircraft, (PR 01A-2018), $1,536,253.

Navy Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, Philadelphia, Pa.

Federal Windows Manufacturing Co., Chicago, aircraft servicing platform, N383-48189 (IFB-383-1931-57), $111,800.

Holley Carburetor Co., Van Dyke, Mich., spare parts for engine N383 (MIS) 48020A, (MIPR33-600-7-02A0262, Amendment 4), $36,041.

Utica Division, Bendix Aviation Corp., Utica, N. Y., spare parts for J65 gas turbine engines N383-48054A, (383-2118-26912-P-6/4/55) $39,238.

Vertol Aircraft Corp., Morton, Pa., ground handling equipment for aircraft (N383-MIS) 47510A, (MIPR-14-604-1-18B-368 Lot 1; MIPR-14-604-7-5120-392 Lot 2; MIPR-14-604-7-18B-404 Lot 3), $25,948.

POTOMAC RIVER NAVAL COMMAND, U. S. Naval Gun Factory, Washington 25, D. C.

American Construction Co., Washington, modernize aeroballistics facilities, bldg. 406, at the Naval Ordnance Laboratory, White Oak, Md., (NYB11374), $672,400.

BUREAU OF AERONAUTICS, Washington 25, D. C.

Specialties Inc., Syosset, L. I., N. Y., angle of attack indicators, NOas 57-727-f, (PD-42-1312-57), $86,837.

AiResearch Manufacturing Co. of Arizona Division, The Garrett Corp., Phoenix, Ariz., air turbine starters, NOas 57-865-f, (PD-43-1223-57), $121,591.

Burner-Holloman Manufacturing Corp., Hyattsville, Md., Terrier guided missile handling equipment, NOrd-17911 IFB 600-1227-57-O, $217,192.

Badger Manufacturing Co., Wickes, Ark., bomb crate, wood, mk. 9, mod. O, for 250 lb. WSF practice bomb, mk. 86, mod. O NOrd-17932-IFB 600-1235-57-O, $215,000.

SUPPLY DEPARTMENT, NAVAL AIR MATERIAL CENTER, Naval Base, Philadelphia, Pa.

American Chain and Cable Co. Inc., Hazard Wire Rope Division, Wilkes Barre, Pa., bridle assembly, steel, launching A3D-1 and -2 aircraft, in accordance with NAEF (SI) drawing 403792, sheet one and two, Revision J; 1,200 ea., N156-35534 (IFB Neg. 156/20154/58Q), $176,736.

Bethlehem Steel Co., Bethlehem, Pa., bridle assembly, steel, launching A3D-1 and -2 aircraft, in accordance with NAEF (SI), drawing 403792, sheets 1 and 2, revision J, 600 ea., N156-36542 (IFB Neg 156/20172/58Q), $94,800.

Gisholt Machine Co., Madison, Wisc., turret lathe, ram type, size 3, 4 and 5, in accordance with Gisholt Machine Co. masterline No. 3 4 and 5, N156-34646 (IFB NEG 156/21379/57Q) 5 ea., $110,201.

The Warner & Swasey Co., Cleveland, lathe, single spindle, automatic chucking, in accordance with Warner & Swasey Co. 1 AC Model M-3020, N156-34681, (IFB NEG 156/21389/57Q), 3 ea., $81,116.

Warner & Swasey Co., Cleveland, turret lathe, saddle type, capacity 9" bar x 59-½" long, in accordance with Warner & Swasey Co. 4-A, model M-3550, 2 ea., Turret lathe, ram type, Size no. 3, in accordance with Warner & Swasey Co. No. 3, model M-1200, 1 ea., N156-34647, (IFB NEG 156/21379/57Q), $115,283.

No Uniforms for Tu-104 Crew

Casually dressed flight crew of Tu-104 which flew from Moscow to U.S. Left to right: K. Malkhasyan, navigator; V. Benderov, leading engineer; V. Kovalev, pilot; N. Mayorov, radio operator; I. Ivanov, flight engineer; and T. Alasheev, ship's captain.

Long Range Planning and Research at Marquardt...

by
Roy E. Marquardt
President

Although ramjet development in the Powerplants Division is the major activity here at Marquardt, there are three other divisions carrying on significant work; Controls and Accessories, Test, and Long Range Planning and Research.

The youngest of these Divisions is Long Range Planning and Research. Headed by John Drake, and numbering 50 engineers, the Division has two primary functions:

PLANNING — anticipating product trends in areas where we now operate or might enter. Actually this planning is done in a staff capacity, and normally the results end up as recommendations.

SUPPORT — to the other divisions, by introducing product improvements which offer promise for the future. These improvements generally involve a small scale program to establish the idea as feasible. This research function also may be concerned with areas which do not fit into present Marquardt projects.

Long Range Planning and Research was begun in 1954. One of its first studies concerned areas where the ramjet can now be used or where it might be used in the foreseeable future. To date some exciting new powerplant cycles have been plotted. Some are variations of cycles now in existence, others are radically different.

Projects also have probed new "exotic" fuels, new types of diffusers, accessory systems, and controls. One phase of Aircraft Nuclear Propulsion is now being explored.

Ground was broken near Newhall, California recently for a research test center. This aerodynamic facility will have testing capabilities to Mach 14.5 as a wind tunnel and Mach 10 for free jet testing with excellent simulation of full scale flight conditions (Reynolds Number). In addition, it will permit simulation of combustion conditions to Mach 8 and altitudes above 150,000 feet.

Within this Division, research engineers will find a spectrum of research engineering opportunities, including:

DESIGN	AERO-THERMODYNAMICS
NUCLEONICS	HEAT TRANSFER
CONTROLS	COMBUSTION

For information about these positions and the professional engineering environment at Marquardt, we invite you to write Jim Dale, Professional Personnel, today.

Roy E Marquardt

marquardt AIRCRAFT CO.
VAN NUYS, CALIFORNIA — OGDEN, UTAH
FIRST IN RAMJETS

To Research Engineers Facing an ENGINEER | BARRIER*
Marquardt Means Opportunity—Research engineers have a veritable spectrum of projects at Marquardt Aircraft, the company where an ENGINEER/BARRIER* has never existed. Here in an engineering environment, you will work with a management that recognizes and rewards the contributions of engineers. Look to your future by looking to Marquardt, today. Address your inquiries to Jim Dale, Professional Personnel, 16551 Saticoy St., Van Nuys, Calif.
marquardt AIRCRAFT CO.
VAN NUYS, CALIFORNIA
OGDEN, UTAH
Shown Here: John Drake, Director of Long Range Planning and Research Division
*ENGINEER | BARRIER – an achievement level beyond which you cannot advance.

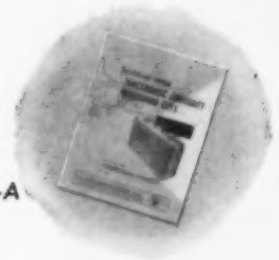
Cox & Stevens
Aircraft Weighing Kits

PUT THE "PAY" IN PAYLOAD

There's no guesswork in achieving optimum payloads with maximum flight safety when the Cox & Stevens Electronic Aircraft Weighing Kit is on the job. Problems of weight and balance can be worked out on the spot. You don't wheel the plane to the scales . . . you take the scales to the plane . . . in a portable case.

Each axle is weighed independently. The wheels are jacked off the ground, with an electronic "load cell" placed between each jack and axle pad. Guaranteed accuracy is within 1/10% of the applied load.

Four sizes of kits are available for weighing the smallest to the largest military or commercial aircraft. Proved operationally under all climatic conditions by leading operators throughout the world for many years.



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Ask for Bulletin C&S-A

REVERE CORPORATION OF AMERICA
Wallingford, Connecticut
A SUBSIDIARY OF NEPTUNE METER COMPANY

neptune

Army Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Army Contracting Offices:

U. S. ARMY ENGINEER DISTRICT, Galveston District, Galveston, Tex.

Automatic Sprinkler Corp. of America, San Antonio, Tex., construction of sprinkler system for hangar, field maintenance, Laredo AFB, Tex., contract no. DA-41-243-eng-3560 (Inv. No. ENG-41-243-58-1), $97,-657.

DISTRICT ENGINEER, FORT WORTH DISTRICT, Fort Worth, Tex.

Texas Bitulithic Co., Dallas, rehabilitation of aircraft fueling facilities, Carswell AFB, Fort Worth, Contract No: DA-41-443-ENG-5038 (INV. No. ENG-41-443-57-53), $463,146.

ORDNANCE WEAPONS COMMAND, Rock Island, Ill.

General Electric Co., Jamaica, L. I., N. Y., 12 items of blanket sections, (1,744 sections) electric, 762MM, rocket XM2, Rock Island Arsenal purchase description RIAPD-583A dated April 3, 1957, IFB ORD-11-199-57-91, $210,643.

U. S. ARMY TRANSPORTATION, Supply and Maintenance Command, Directorate of Procurement and Production, St. Louis.

Duschak's Helicopter Rotor Service Inc., Torrance, Calif., contractual maintenance for standard configuration and modification maintenance, flight test of H-23 type U. S. Army helicopters, 30 ea., Contract: DA 23-204-TC-271-(RFQ Nr 268-B) $44,700.

AMC Contracts

Wright-Patterson AFB Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

Sperry Gyroscope Co., Great Neck, L. I., N. Y., $3,984,471 for components for APN-59.

Transocean Air Lines, Oakland, Calif., $2.3 million for air base services including messing and billeting.

Lockheed Aircraft Services Inc., Ontario, Calif., $1,764,794 for IRAN and modification of RC-121 aircraft.

Page Airways Inc., Rochester, N. Y., $1,-039,629 for storage and maintenance of government-owned machinery and equipment in plant 40.

Douglas Aircraft Co. Inc., Tulsa, $1,782,-055 for IRAN and modification of B-47 airplanes.

Flying Tiger Line, Burbank, Calif., $4,626,531 for air transportation service from Travis AFB, Calif., to Tokyo and return.

Tumpane Co. Inc., Omaha, Neb., $2,270,-311 for follow-on maintenance and operation of machine tool storage site.

Seaboard & Western Airlines Inc., New York, N. Y., $1,560,027 for air transportation service from New York International Airport to Burtonwood, England, France, Germany and return.

World Airways Inc., Oakland, Calif., $1,107,069 for air transportation service from Japan to Okinawa, Formosa, Manila and return.

Robert E. McKee General Contractors Inc., El Paso, Texas, $2,157,300 for construction of cadet academic area.

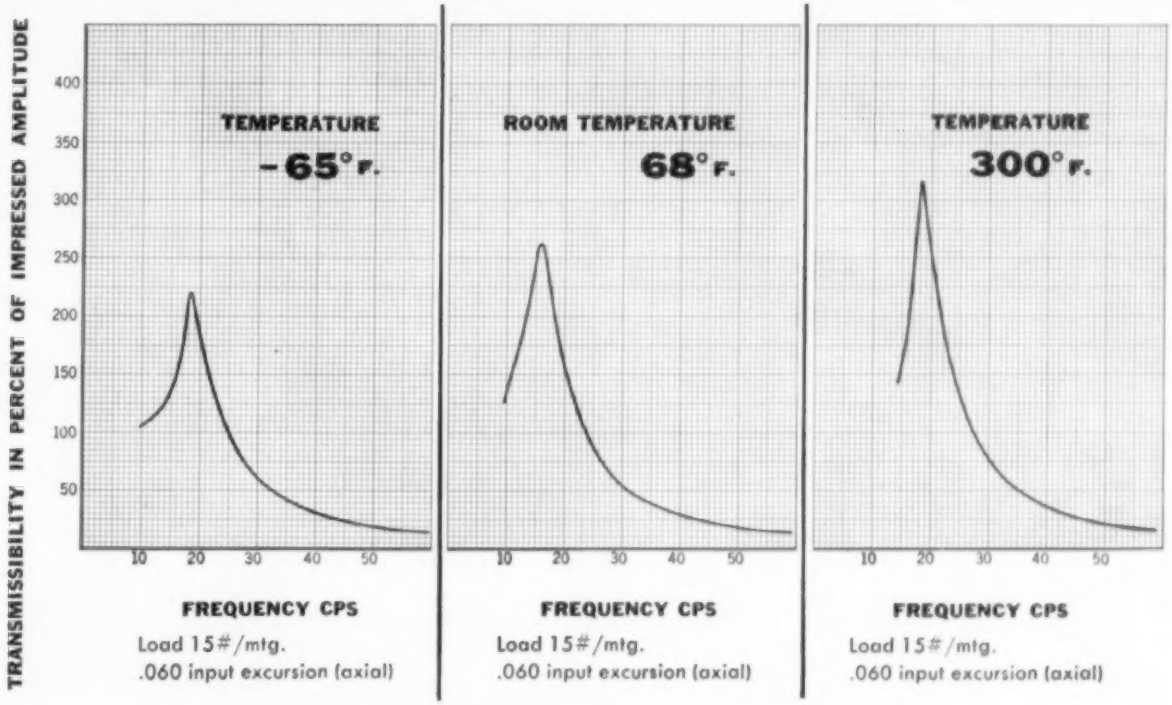
Philco Corp., Philadelphia, Pa., $1,808,-914 for aircraft central and warning site maintenance for Eastern and Western Air Defense Forces.

Radio Corp. of America, Service Co. Inc., Camden, N. J., $1,272,289 for exercises of option to procure additional on-site maintenance of aircraft control and warning in Central Air Defense Force.

Aerodex Inc., Miami, $1,160,850 for additional procurement for overhaul of aircraft engines.

Goodyear Aircraft Corp., Akron, Ohio, $1,109,864 for incorporation of engineering changes and flight testing of guidance system.

Broad Temperature Range elastomers for **LORD** bonded rubber mountings



BROAD TEMPERATURE RANGE — Transmissibility curves for LORD Mounting with new type *BTR* elastomer indicate that temperature extremes produce minimum change in physical properties. Transmissibility at resonance is three or less at 68°F. or lower temperatures, and 3.5 or less at 300°F.

■ A new type Broad Temperature Range elastomer with resistance to temperature extremes is now available from LORD Manufacturing Co.

This new material is used in performance-proved LORD mounting designs to assure superior vibration isolation under severe environmental conditions. It is resistant to oil and ozone, and functions efficiently in temperature ranges from −65°F. to 300°F. Its proven mechanical properties include high tensile strength, high tear resistance, and good flex life. The hysteresis characteristic of the material eliminates the need for auxiliary dampers, which generate harmonics destructive to mounted equipment.

For further information on this new elastomer, contact your nearest LORD field engineer or the Home Office, Erie, Pa.

ATLANTA, GEORGIA · CEdar 7-1123
BOSTON, MASS. · HAncock 6-9135
CHICAGO, ILL. · Michigan 2-6010
CLEVELAND, OHIO · SHadyside 9-3175
DALLAS, TEXAS · Riverside 1-3392
DAYTON, OHIO · Michigan 8871
DETROIT, MICH. · TRinity 4-2060
KANSAS CITY, MO. · WEstport 1-0138
LOS ANGELES, CAL. · HOllywood 4-7593
NEW YORK, N. Y. · Circle 7-3326
PHILADELPHIA, PA. · LOcust 4-0147
"In Canada—Railway & Power Engineering Corporation Limited"

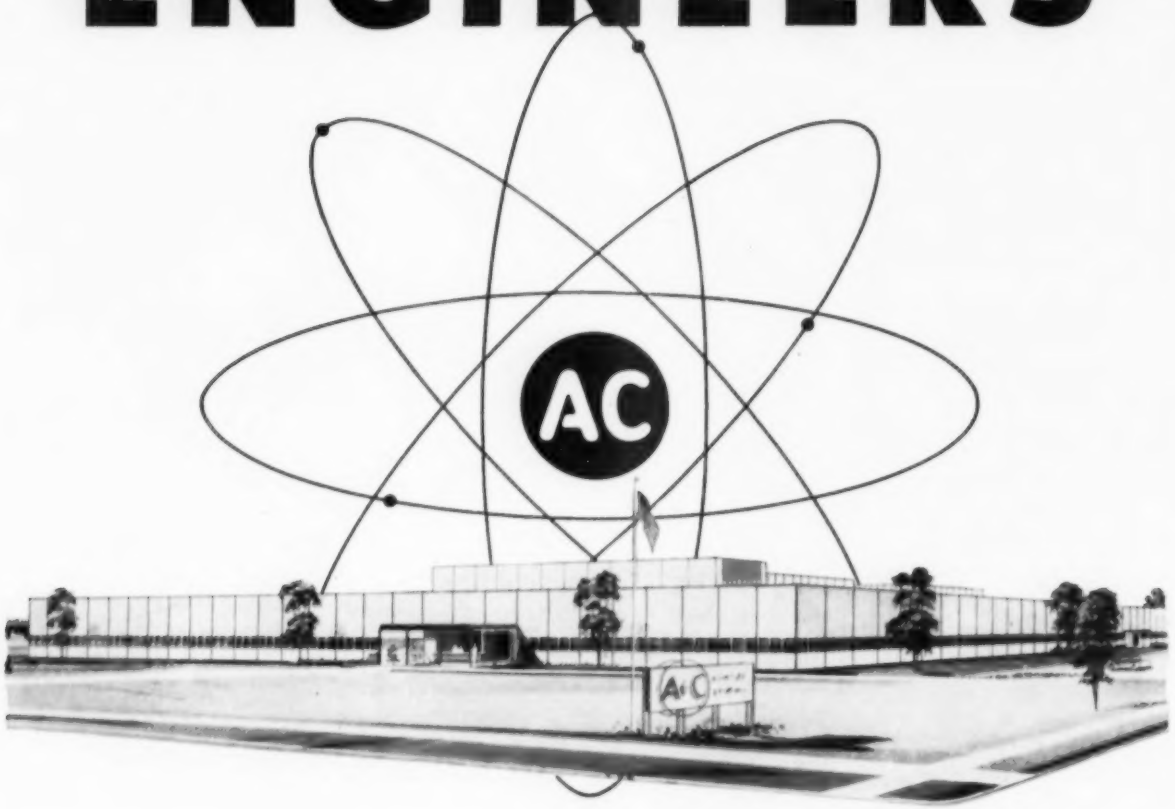
LORD MANUFACTURING COMPANY · ERIE, PA.

LORD
BONDED RUBBER

designers and producers of bonded rubber products since 1924

PROJECT AND SENIOR PROJECT ELECTRONIC

ENGINEERS



With a BS degree in EE or ME and at least three to ten years applicable Electronic experience for key positions with AC—The Electronics Division, General Motors Corporation.

We need a few more highly analytical systems engineers; equipment engineers versed in our "hardware"; engineers with actual field testing, telemetering, evaluation analysis, set-up of environmental testing, etc.

We work in every phase of Research, Design, Development, Reliability and Production in these exciting fields:

AVIONICS **INERTIAL GUIDANCE**

COMPUTERS (Analog-Digital) **JET ENGINE FUEL CONTROLS**

Automotive—Aeronautical—Electro-Mechanical Devices

You will enjoy working with the top men in the field, utilizing the finest of test, research and development facilities. The above plant, just added in suburban Milwaukee, is part of our major expansion program.

Rewarding, satisfying, challenging permanent opportunities await qualified engineers.

You and your family will enjoy Milwaukee's "small town hospitality" and "metropolitan shopping and cultural advantages."

For immediate, confidential interview in your area or an invitation to visit Milwaukee at our expense and discuss your potentialities with our staff engineers, send resume today to *Mr. Cecil E. Sundeen, Supervisor of Technical Employment.

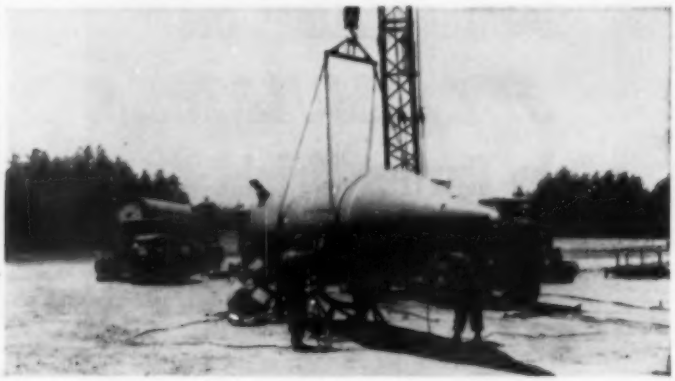
AC THE ELECTRONICS DIVISION

General Motors Corporation

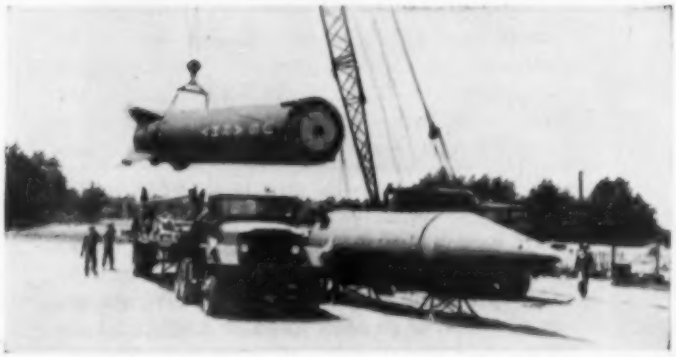
Flint 2, Michigan • *Milwaukee 2, Wisconsin

Army Missile Unit Assembles Redstone

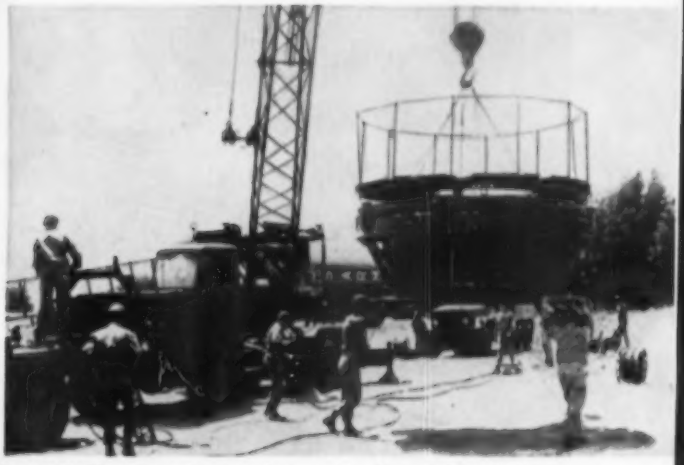
REDSTONE body, with warhead, guidance, is lowered on cradle.



THRUST unit is moved up for mating with frontal section.



THRUST section (above) consists of fuel tanks, propulsion system, tail.



LAUNCHER (above) is spotted to receive the missile, which is lying horizontally behind crane.

CABLES (left) which convey pneumatic pressure to missile are attached to multiple coupling on valve box of launcher. Above, band of frost forms above tail as alcohol and liquid oxygen flow into missile tanks.

3 MORE of the world's leading airlines order JET SIMULATORS by Curtiss-Wright

AIR FRANCE LUFTHANSA

SABENA
BELGIAN World AIRLINES

BOEING 707 JET SIMULATOR

Air France, Lufthansa and Sabena are the latest in the register of the world's foremost airlines which have selected Jet Simulators by Curtiss-Wright.

These leading airlines have one thing in common—years of experience in providing the ultimate in passenger service and comfort. To maintain and extend their high level of operations into the jet transport age calls for precision crew training in every aspect of jet operations. For this purpose the unanimous choice of these worldwide carriers is the electronic flight Simulator built by Curtiss-Wright.

Many of the airlines purchasing Jet Simulators have long experience with one or more of the 25 types of Flight Simulators designed and built by Curtiss-Wright. Simulators by Curtiss-Wright are in operation or on order for more commercial airlines than are those of all other manufacturers combined. Watch for other leading world airlines to select the advanced performance and fidelity of Flight Simulators by Curtiss-Wright.

ELECTRONICS DIVISION
CURTISS-WRIGHT
CORPORATION • CARLSTADT, N. J.

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NEW BUSINESS PLANES, including Acme jet amphibian (mockup, foreground), showed Denver citizens the industry's growing scope.

Explosive Business Flying Growth Seen

By Erwin J. Bulban

Denver—Active partnership in U.S. programs to modernize aviation facilities was offered business flyers by a White House official during National Business Aircraft Assn.'s 10th Annual Meeting & Forum here.

This major political breakthrough, together with a display of jet-age technical developments that promise to have explosive effects on the U.S. aviation economy, forecast further increases in rate of growth of business flying, paving the way to a dominant position in the aviation industry in the next few years.

These developments, a cross section of what occurred at the biggest and most successful NBAA meeting yet, follow in detail:

• **Invitation by E. R. Quesada,** special assistant to President Eisenhower and chairman of the influential Airways Modernization Board, to business flyers' representatives to participate in AMB's program to modernize completely U.S. aviation facilities. This type of recognition from a high level in government has eagerly been sought by business flyers for years; its lack had caused embittered feeling toward military and airlines for years.

Personnel Needed

Asking for the "stanch support" of NBAA and all other segments of general aviation, Quesada told business flyers that AMB's philosophy is to acquire personnel on a full-time basis with background and experience in various types of flying in the U.S.

He stated that he is asking General Aviation Facilities Planning Group, of which NBAA is a member, to suggest the name of a man who would serve as a spokesman, from time to time, for all non-military and non-airline aviation before the Board to advise it of business and private flying requirements, objectives, policies and capabilities.

Quesada said that he also wants one or two general aviation pilots full-time to work with AMB's engineers and technicians to make sure that its personnel "don't develop technically beautiful pieces of equipment—but virtually worthless to the practical pilot."

In addition, he wants about six general aviation people who will work for the government for less than $10,000 a year as civil service employes.

AMB will explore and get facts on airport facilities needed for general aviation at terminals where high-and-low-performance aircraft mix in all kinds of weather, Quesada said.

• **Placement of orders** by large corporations for positions on the production

Aero's Design for TODAY...

AERO'S PROGRAM FOR INCREASED PRODUCTION, world wide sales and service, was initiated months ago when construction of our new plant was begun.

TIME TABLE for a PRODUCTION Miracle!

SEPTEMBER:
Plans accelerated to complete new plant weeks ahead of schedule.

OCTOBER:
Installation of machinery and tools and manufacture of component parts begins.

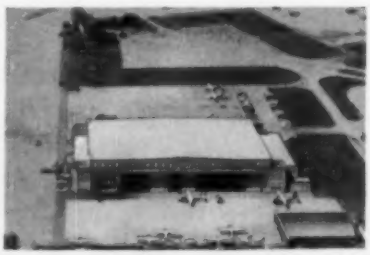
NOVEMBER:
Start fabrication of major aircraft assemblies.

DECEMBER:
Delivery of aircraft for painting and modification.

JANUARY:
Begin customer delivery of NEW COMMANDERS, The World's Finest Executive Aircraft.

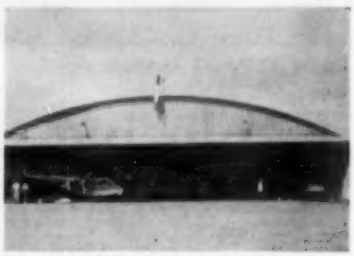
TODAY . .

AERO'S engineering research facility at Norman, Oklahoma is operating at peak efficiency.



TODAY . .

installation of equipment and instruments is on schedule at the modification center at Cimarron Field.



TODAY . .

as always AERO'S parts warehouse at Tulakes is completely stocked with Commander parts. Every service requirement is being fulfilled promptly.

AERO Commander

"THE CHOICE OF MEN AT THE TOP"

AERO DESIGN & ENGINEERING CO TULAKES AIRPORT, OKLAHOMA CITY

lines that will build the new generation of multi-engine executive transports foreshadows the technical revolution that will affect every segment of business flying including manufacturing, sales, service, maintenance and operations.

Fairchild announced that it already has orders for executive versions of its F.27 turboprop transport from 14 corporations. Grumman reports that 15 positions on its Model 159 Gulfstream turboprop transport line are spoken for; On Mark has orders for its Allison-turboprop-powered 450 Marksman from Maytag and Phillips Petroleum; Lockheed has received a number of requests for production priorities for its CL-329 Jetstar, includes Dresser Industries and Swiftflite among them.

Prices and delivery dates quoted by these manufacturers were:

• **Lockheed Jetstar** will cost slightly under $800,000, minus engines, special radio and radar; slightly under $1 million with standard interior and equipment. Lack of clear-cut data on engine costs does not allow the company to estimate what full price will be, a company spokesman noted. Lockheed is quoting mid-1960 delivery dates.

• **Fairchild F.27** is priced at $590,000 with Rolls-Royce RDa. 6 Darts and $650,000 with RDa. 7 engines—in both cases minus interiors and plug-in radios. Standard interiors fitted to scale models on display by the company were estimated at costing $35,000-$45,000 extra. F.27 deliveries are scheduled to start in June 1958, the company noting that it has just one delivery slot open remaining for 1959 delivery.

• **Grumman 159 Gulfstream** will cost approximately $700,000 for the basic airframe delivered from the factory to a distributor, with interior and electronic equipment to be installed (AW Sep. 30, p. 27). It is estimated that the airplane fully finished will cost about $900,000. Deliveries will begin in 1959.

• **On Mark 450 Marksman** will cost $1,180,000 complete with interior to customer's order, exterior paint and including installation of customer-desired radio and navigation gear. Deliveries are scheduled to start in May 1959.

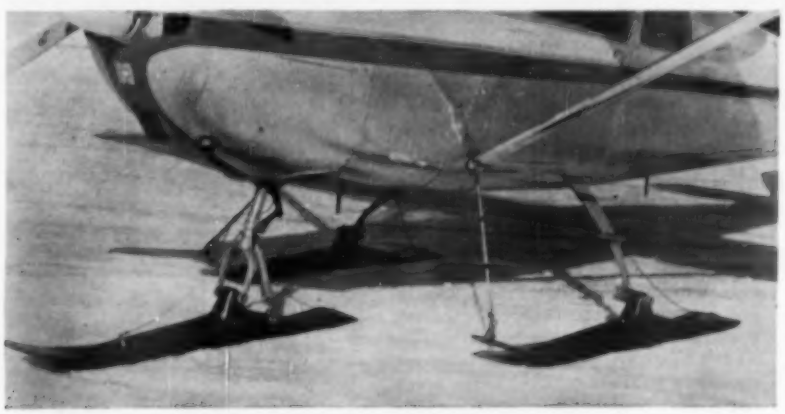
Lockheed maintains that production of the Jetstar is contingent upon military orders, but it appears confident that these will be forthcoming. Company feels that USAF will take procurement action on the airplane early next year. To come out with the first hardware the company has invested nearly $6.5 million of its own funds.

Production Plans

Jetstar is to be transferred to Marietta, Ga., where the company has already named B. B. Bundesman commercial sales manager for the project.

Lockheed production schedule calls for first 15 or 20 Jetstars to be delivered to Air Force by Marietta; civilian output would be sandwiched in with succeeding military airplanes. Company will have a prototype available for evaluation flights by corporate pilots in mid-1958, a spokesman told AVIATION WEEK.

Jetstar will have a direct operating cost of about 37 cents/plane mile, according to one of the companies which has obtained a priority production line position. The prospective purchaser said that this was less than his current rebuilt PV-1s, and he added that the Jetstar will be capable of op-



Plastic Skis Reduce Sticking

Fiberglas-reinforced polyester plastic skis, fitted to a Cessna 172, are reported by the manufacturer to be increasing in popularity among Alaskan bush pilots. Freeze-down and sticking under varied snow conditions is reduced, compared to gear made of other materials, maker says. Certificated by Civil Aeronautics Administration, the plastic skis are priced from $195 to $425, depending upon size. Manufacturer is Airglas Engineering Co., Box 1254, Anchorage.

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JUST PUBLISHED. NEW SECOND EDITION! Simply and clearly written, this book describes the various types of gas turbines, rockets, ramjets, and pulsejets. Thoroughly explains theory, nomenclature, components, accessories, and related systems. Supplies design details for specific engines, takes up applications in transport aircraft, and gives maintenance and overhaul procedures. **By J. V. Casamassa, Russell Assoc., Inc. and R. D. Bent, Northrop Aero. Inst. 329 pp., 240 illus., $10.75**

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This Sperry system provides azimuth drift rate as low as 1/4° per hour, and in the vertical axis, 1/10° per minute. The use of twin directional gyros and new design technique permits this extreme accuracy as it minimizes the disturbance torques inherent in conventional gyros. The low drift in the vertical axis minimizes turning error—permits freedom from erection control for longer periods of time.

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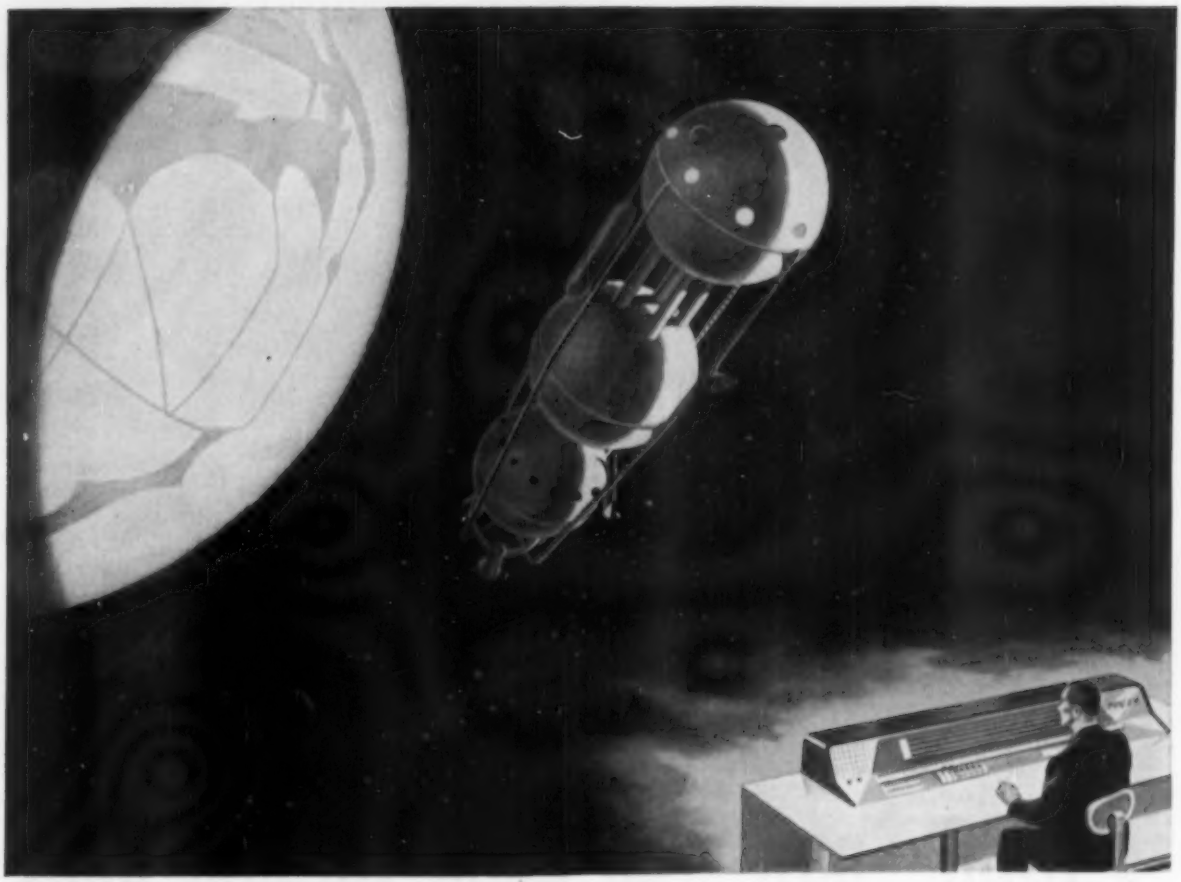
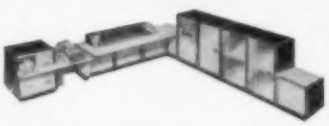


Large Scale Computers Speed Engineering and Astro-Navigational Data Processing For Coming Interplanetary Travel!

Philco Transac* S-2000 Computer



Here is the world's first all-transistor, large-scale integrated data processing computer. Years ahead in design and performance, it's another outstanding achievement of Philco research and engineering.

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Toward this end, the U. S. Government, Armed Services, Industry and International Science are joining forces for research and experimentation.

Modern large scale Integrated Data Processing Systems are invaluable in compiling, coordinating and analyzing the huge volumes of significant data being collected. Only through these giant electronic "brains" can the complex calculations involved in the design, engineering, launching and navigation of space ships be accomplished with necessary speed and accuracy.

Tomorrow's interplanetary space ships are but one example of the huge data processing projects which will utilize amazing digital computers to cut engineering manhours to a fraction.

Fulfilling the nation's need for faster, more reliable and compact large-scale data processing systems, Philco is proud to present TRANSAC S-2000.

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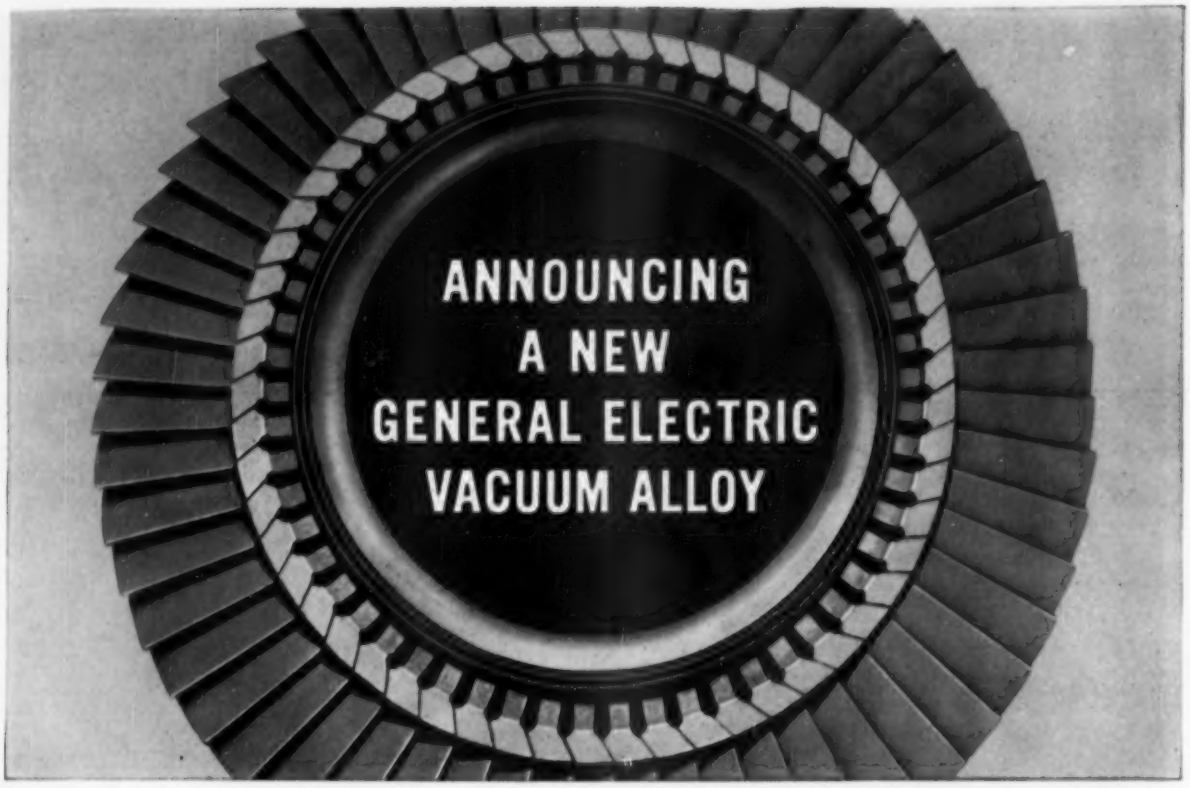

J-1300—new iron-base turbine alloy

Easier to forge . . .
higher strength-to-weight ratio
than existing iron-base alloys

New General Electric vacuum-melted alloy J-1300 is specially designed for large forgings, such as turbine wheels, rings, shafts, and buckets. It has the highest strength-to-weight ratio of any iron-base alloy in the 1300° F range.

Its rupture strength at 1300° F is comparable to that of other iron-base alloys at 1200° F. Its minimum guaranteed tensile strength at 1200° F is 135,000 psi.

In addition to its greater strength, J-1300 is more ductile — making it easy to forge. And its improved properties are easy to control and maintain during forging.

G-E alloy J-1300 is currently available in billets and bars. Substantial quantities have been made, and guaranteed minimum specifications are available. For complete technical data, write for Bulletin VM-104. Metallurgical Products Department of General Electric Company, 11107 E. 8 Mile Avenue, Detroit 32, Michigan.

PROPERTIES OF J-1300

Tensile strength at 1200° F
Ultimate — 135,000 psi
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Elongation — 12%
Reduction of area — 15%

Rupture strength at 1300° F
65,000 psi — life, 24 hours

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GENERAL ELECTRIC

LOCKHEED SAYS that Jetstar output awaits military orders, nonetheless many companies are seeking positions on production line.

crating into any field that the PV-1 now gets into. Same operator made the comment that he would like to see the Jetstar's nosewheel steering control moved over to the copilot's side of the cockpit.

On Mark's 450 Marksman Allison-turboprop-powered executive transport (AW Oct. 7, p. 32) will have "blowout doors" in its pressurized cabin so that in event of loss of pressure, passengers can evacuate the affected portion and retreat to another compartmented section of the cabin, which can then be re-pressurized. This feature will obviate necessity for rapid letdown to continue to an alternate field at lower, less efficient altitude, On Mark President Robert Denny said.

Denny also reported on these features:

- **Allison engines,** designed for JP-4 operation, can use piston-engine fuels if necessary by adjustment to engines that takes five minutes. JP-4 consumption will be approximately 132 gph. using 2,015-eshp. cruise power.
- **Performance stretch** is built into the airplane and it will be able to take later development of Allison 501D-21 engine turning out 4,000 eshp., considerably boosting current design 400-mph.-plus cruise speed.

Beech Development

Beech aircraft detailed its development in the turbine-powered executive transport field, covering a number of design studies the company has underway on a Beech 18 replacement.

According to a market survey made by the company, there is a large demand for a 10-place 350-mph. aircraft, but Beech studies show that price of this airplane would be nearer $500,000 than the $350,000 that prospective customers would be willing to pay.

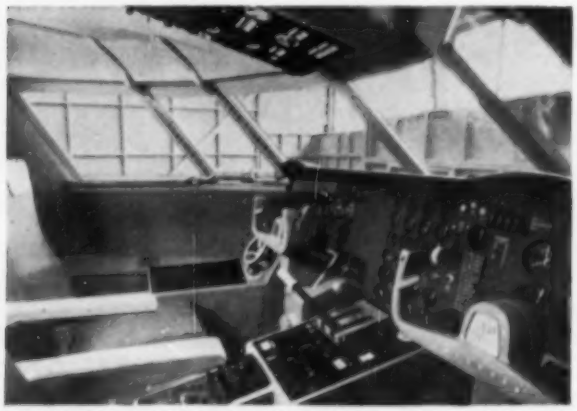
Company is investigating a whole family of jet and turboprop projects aimed at covering the widest possible market. One particular aircraft design study in its PD-112 study is a Lycoming T53-powered twin which would seat six passengers, cruise at 300 mph. at 15,000 ft. and have a range of about 1,200 statute miles at this speed with 2,900 lb. of fuel. Zero fuel weight would be 13,218 lb., gross weight 16,350 lb. Basic empty weight would be 10,813 lb. with full radio and navigation equipment, including usual dual installations and 670 lb. of optional gear, electrically anti-iced windshield and radar.

Beech feels that price would be in the neighborhood of $650,000-$700,000, fully equipped, ready to operate, if a firm market for about 200 aircraft was certain.

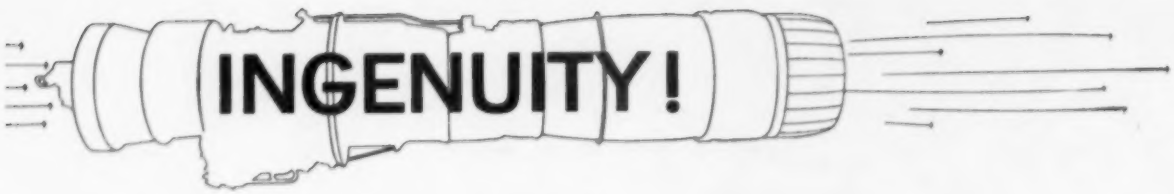
Beech is not waiting on these projects. There are strong indications that it will import a number of Morane-Saulnier MS-760 twin-jet four-place executive planes soon under an agreement with the French manufacturer.

Strengthening this observation was an invitation to business pilots at Denver by a Beech representative to "buy it (MS-760) now and fly it a million miles before a competitive type aircraft is available."

Indications are that these new entries



EXECUTIVE JETSTAR MOCKUP provides preview of cockpit layout (left), cabin seating layout. Aisle headroom is 6 ft. 2 in.



You'll see this used quite a lot by our jetmakers. It's the combined application of imagination and engineering skill that results in a better way or method for making a product—like this special inert gas chamber we designed for controlled atmosphere welding of titanium.

You see, we operate on the principle that *anything* can be made better or more quickly.

Our engineering and production specialists are constantly examining production methods to determine if new ways can be found to increase the quality of the job and, at the same time; lessen production time and cost.

In some instances, we have sliced production time in half on certain manufacturing operations of the J57. Of course, it takes skill, experience . . . *and ingenuity*.

Our jetmakers have a lot of each.

This ingenuity is an important factor enabling us to deliver quality jet engines, on schedule, at the lowest possible cost.

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in the business flying market will be a tremendous spur to growth and expansion of the industry. Reasoning is that large-scale advertising, sales and promotion campaign efforts added by newcomers like Lockheed, Fairchild, Grumman and On Mark to those by established firms such as Beech, Cessna, Piper and Aero Design will establish a higher rate of demand for all types of business aircraft.

Past experience has shown that many large companies purchasing heavy multi-engine equipment also find a need for smaller, light twin and single-engine types to provide economical shorthaul airlift.

Check of manufacturers present at Denver showed that despite soft spots in some parts of the nation's economy, business aircraft demands are still climbing. Piper distributors, for example, are anxious to get deliveries of the new low-wing four-place Comanche; a Beech spokesman told AVIATION WEEK that the company could probably sell 250 new Travel Air light twins this year, if they were available.

New Joint Efforts Sought by Pyle

Denver—Two major problems in executive air transport are upgrading of crews so that they can not only handle modern types but are also completely familiar with capabilities and limitations, and maintenance of continuing instrument proficiency, CAA Administrator James T. Pyle told National Business Aircraft Assn. members here.

In both these areas, the safety picture is spotty, Pyle stated, and must be jointly solved. "We must," he said, "come up with sound programs of pilot training, clear-cut and effective flight test procedures and top it off with a realistic program of periodic pilot proficiency."

Pyle also noted that pressure is building up among major aircraft modification firms to reduce the amount of time required for CAA approval of these changes. An industry committee recently met with him on this subject, he said, and top-level Washington technicians are working with industry in expediting and clarifying procedures required for such approvals.

PRIVATE LINES

Beech D-18S modification, designated the Pagan, features three-blade Hartzell propellers, Super 18 wingtips, cleaned-up exterior, new wing tank fuel system that frees nose for radar installations. Empty weight, including radio and all standard equipment is 6,225 lb., providing useful load of 2,775 lb. Cruise speeds at maximum gross weight, using 300 hp. per engine is reported as 281 mph. at 10,000 ft.; 207 mph. at 5,000 ft. Using 260 hp. per engine, speed at 10,000 ft. is stated to be 205 mph.; using 240 hp. at same altitude, cruise speed is 199 mph. Pagan D-18S configuration is priced at about $95,000 with radio and interior. Modification is by Chamberlain Aviation, Inc., Akron, Ohio.

Safety harness for stretcher cases, developed by McRobertson Miller Airlines, attaches to the aircraft floor and holds patient and stretcher by special set of seat belts clipped to cargo rings.

Bendix GSA-8A glide slope receiver, to be available early next year, features all point-to-point wiring on one side of case and all tubes and adjustments on reverse side for maximum accessibility. New equipment will list for about $1,000.

Completely transitorized RCA marker beacon, AVR-200, weighs less than three pounds and features a universal power supply operating from either 28 v. d.c. or 115 v. a.c. Unit has printed wiring boards to minimize maintenance, receiver is said to require less power than any of the three market lights it activates. Housing is short ¼ ATR.

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1958

Aviation Week

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MOOG

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RCAF Receives First Canadair Argus

First Canadair Argus to be turned over to the Royal Canadian Air Force, the third aircraft to fly, is accepted by Canadian Defense officials at ceremony at Montreal (below). Second aircraft, which has flown more than 22½ hr., has added some antennas and instrumentation (above) which first airplane did not have. These include static pitot tubes near nose observer, some type of dipole antenna near cockpit, VHF antennas on top of fuselage.

Answers to the Toughest Problems in Jet Aircraft Cooling...

LIGHTWEIGHT...THINWALL

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Stewart-Warner's unexcelled experience can be used to meet *your* heat transfer needs!

Ram and blower heat exchangers—designed for Stratos refrigeration system used on Boeing B-52

Air-to-air Model 961-A—designed for the Hamilton Standard refrigeration system used on Chance-Vought F8U-1 "Crusader"

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The South Wind Division of Stewart-Warner pioneered the development of heat exchange equipment for heating modern aircraft. Now South Wind is the leading producer of heat exchangers for *cooling*. Lightweight thinwall units in both stainless steel and aluminum—either air-to-air, air-to-liquid, or air-to-evaporating-liquid—are being designed and fabricated for a wide range of new and important uses. If *you* have a heat transfer problem, South Wind engineers can help you solve it. No obligation. Write to South Wind Division, Stewart-Warner Corporation, Indianapolis 7, Indiana.

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Rough Field Tire Deflates in Flight

Los Angeles—Progress in the development of a low pressure pneumatic tire for assault transports operating from unprepared fields was reported to the National Aeronautic meeting of the Society of Automotive Engineers by V. Frisby of Fairchild Engine and Airplane Co.

Because of its unusual size, experimental tire is designed to be deflated and collapsed in flight like a helical bellows to minimize drag and airframe volume requirements.

The tire inflation system is also designed to bleed off some tire pressure automatically as sink rate is dissipated in the landing.

The purpose of this is to maintain the product of footprint area times tire pressure approximately constant until sink rate is totally dissipated, thus controlling rebound.

Operating conditions of assault transport landing gear differ from those of conventional landing gear in four respects.

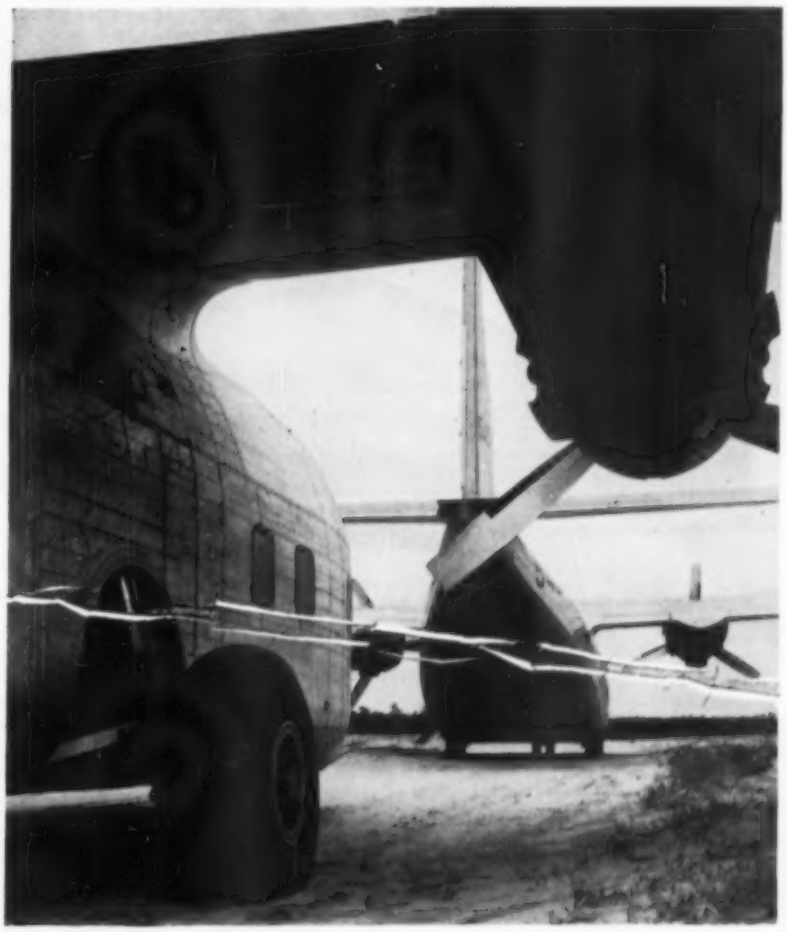
- **While rolling resistance** of conventional gear on pavements is small relative to vertical load, on unprepared fields, rolling resistance may be as much as half the vertical load.
- **Rolling resistance on pavements** is nearly constant regardless of speed, but on unprepared fields of low shear strength soil, rolling resistance of low pressure tires may be expected to diminish as speed increases.
- **Reaction of pavement** to aircraft loads is not subject to moisture content as is the case of unstabilized soil.
- **Unprepared fields** are not plane surfaces, and corrugations, potholes, bushes, etc., must be expected.

Very low pressure tires should have lower rolling resistance on low shear strength soils than higher pressure tires and probably less than skis. Most attractive characteristic is their ability to accommodate surface inequalities.

Weight of low pressure tires built by conventional methods would probably be prohibitive. The experimental tire is fabricated by other techniques which give tire weight equal to about one percent of rated load for a configuration giving deflection and footprint area required.

The tire is of high tensile nylon and natural rubber. Tire cord is wound in one continuous strand over collapsible male mould. All cords are tangent at hub or bead of tire. Designers hope that maximum stress in all cord is about equal for the most severe tire deformations.

ANOTHER Fairchild development for assault transports is a wide tread main landing gear on its C-123. New gear extends to the side with wheel well cover attached at bottom. Standard gear on plane in foreground (below) extends vertically and has wheel well cover hinged at top. Fairchild said tests have shown new gear is an improvement.



a cool motor for hot aircraft

Unique construction of Westinghouse gearhead motor assures maximum horsepower...even at high temperatures

Westinghouse aircraft gearhead motor meets requirements of MIL-M-7969A. Totally enclosed, fan cooled, explosion-proof. Continuous duty ratings of 1/6 to 2½ hp available within speed range 1050-3000 rpm. Higher ratings available for intermittent duty.

Faster — Higher — HOTTER!

Today's aircraft demand electric motors that can operate in ambients far above normal — at no sacrifice in efficiency.

The lightweight Westinghouse aircraft gearhead motor meets this challenge. The unique finned frame provides an extra-large area for dispersal of internal motor heat. An external fan and shroud channels air over the fins, driving off the heat quickly, efficiently. The rotor design itself provides an efficient *internal* circulation of air without the added weight of a separate internal fan.

Result — this Westinghouse motor operates at a maximum horsepower-to-weight ratio regardless of surrounding temperatures.

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AIRCRAFT EQUIPMENT DEPARTMENT, LIMA, OHIO

Details Revised In Wheel Mover System

New York—Fluidity of the concept of propelling heavy jet aircraft with wheel movers has resulted in several idea changes by the originators of the concept, Consolidated Diesel Electric Corp., since details of the system were publicly revealed (AW Oct. 7, p. 137).

Here are the latest revisions and additions:

- **Two hydraulically-powered** wheel movers—not four—will normally be used to move plane. Units will be attached to forward, inboard wheels of the plane's four-wheel bogie main gear.
- **Dummy wheel movers** will be installed on outboard forward wheels. Yoke between the real and dummy movers will serve to push the power vehicle. Arm from yoke to main wheel strut will serve as torque reactor.
- **Dummy movers** can be replaced with actual power units in case four movers are required under extreme conditions of ice or snow. Addition of two extra movers will cut maximum speed of plane movement in half, from 5 mph. to 2½ mph.
- **Single throttle-type** lever may be used to control speed and direction of rotation of both wheel movers, allowing pilot to steer the plane through the nose wheel. Present control uses two levers, one for each wheel.
- **Power of wheel mover** may be transmitted to plane through a set of expanding brake shoes reacting against the inner rim of the main wheels. Power to expand the brakes will be taken from the power vehicle's hydraulic pumps.

Plan is to try ring gear on prototype installation, expanding brake shoes on the next installation. If brakes work, production units will be standardized on their configuration. If problems arise, such as foreign matter or ice on the wheel rims, making use of brakes impractical, Con Diesel plans to return to the ring gear. Company says that Bendix Products, maker of the wheels, has agreed to cast the ring gear integrally with production wheels if its airline customers want it to.

- **Wheel mover system** has been proposed to Lockheed Aircraft Corp. for use on its C-130 Hercules. Proposal has been transmitted to the Air Force for consideration.

Idea is that when the C-130 is used as assault troop transport, it may be be required to land on unprepared fields with the possibility of miring down in soggy terrain.

To retrieve a plane the size and weight of even an empty C-130 under such conditions could become a major operation. Consolidated Diesel engineers believe that their wheel movers, coupled to the aircraft's four main

First in a series, *"Earliest History of Aeronautics"*

FLIGHT TEST 400 BC

Archytas and his wooden pigeon

Historians and archeologists have recorded legends and mythology dealing with flight as far back as 3500 B.C. However, it is not until 400 B.C. that history records the first actual flight experiment distinctly removed from pure mythology.

Archytas, brilliant Greek philosopher, scientist, mathematician and general, is credited with constructing a wooden, self-powered flying dove. While this historic episode has been discussed and investigated for twenty centuries, a logical scientific explanation is still lacking. Theories offered to explain the alleged flight have been many—a lighter-than-air wood unknown to us today, the use of a gas within the model, and even a mechanical device which may have been the forerunner of combustion engines. Most researchers think of Archytas' accomplishment as "possible but incredible."

Aeronautical Testing, 1957 A.D.

Today's aeronautical engineers and scientists make use of facilities such as Archytas never dreamed of... facilities like Aerotest Laboratories, a single source of complete aircraft and missile equipment testing—functional and environmental—in accordance with all military and commercial specs.

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The salary is open. Replies will be treated in strictest confidence; references will not be contacted without permission. Please write in detail to

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The price of bulk oxygen has dropped about 80% in 12 years, while most other prices have risen. Oxygen is now being produced in large quantities for a few dollars per ton.

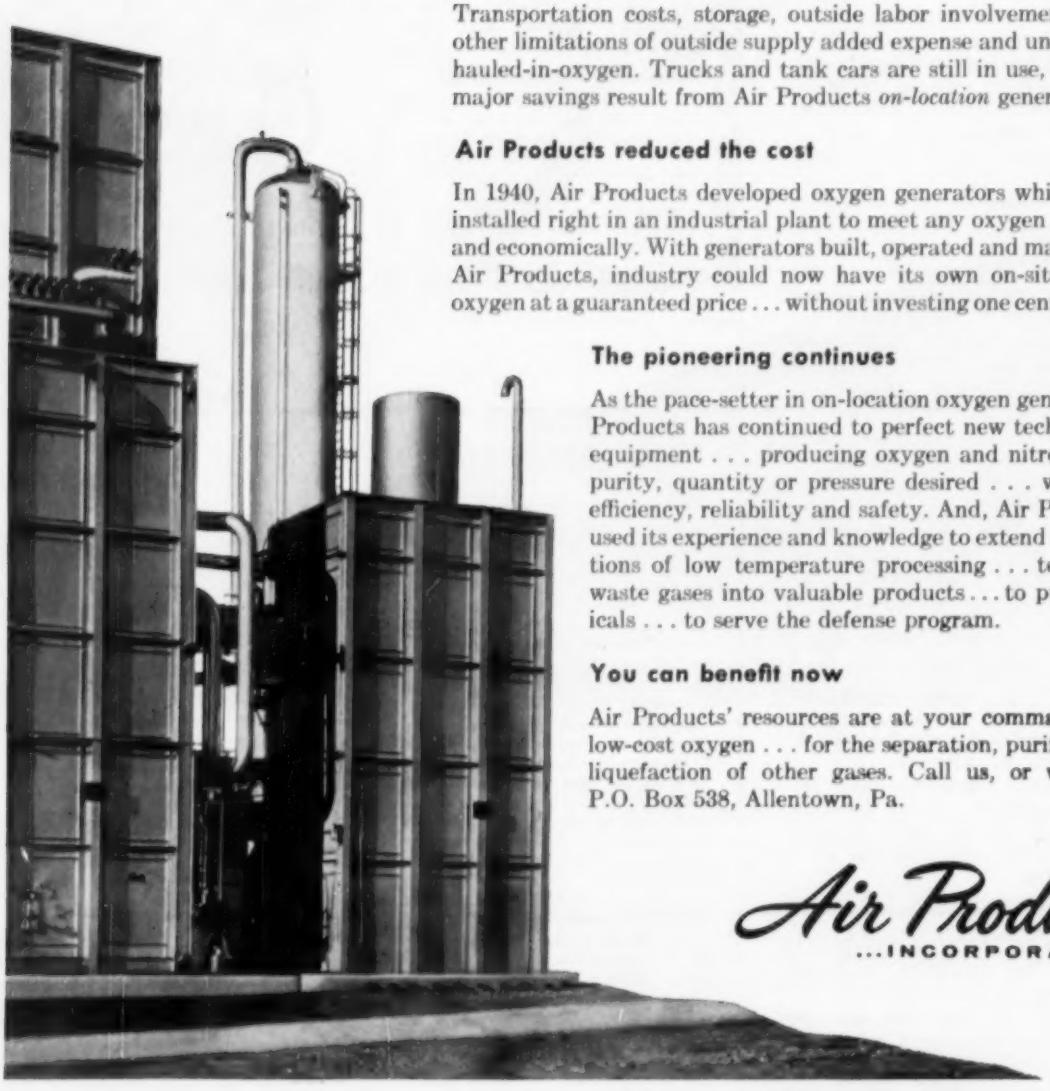
Oxygen isn't the high-priced chemical it used to be. Now, it's a low-priced tonnage commodity—a utility purchased like electricity or water. The price drop is the *real reason* oxygen usage has climbed beyond 70 billion cubic feet per year.

Why was it costly?

Transportation costs, storage, outside labor involvements and the other limitations of outside supply added expense and uncertainty to hauled-in-oxygen. Trucks and tank cars are still in use, but today's major savings result from Air Products *on-location* generation.

Air Products reduced the cost

In 1940, Air Products developed oxygen generators which could be installed right in an industrial plant to meet any oxygen need, safely and economically. With generators built, operated and maintained by Air Products, industry could now have its own on-site supply of oxygen at a guaranteed price . . . without investing one cent of capital.



The pioneering continues

As the pace-setter in on-location oxygen generation, Air Products has continued to perfect new techniques and equipment . . . producing oxygen and nitrogen in any purity, quantity or pressure desired . . . with greater efficiency, reliability and safety. And, Air Products has used its experience and knowledge to extend the applications of low temperature processing . . . to transform waste gases into valuable products . . . to purify chemicals . . . to serve the defense program.

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Air Products
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Hundreds of Air Products package generators and tonnage plants are now on stream . . . capacities range from ½ ton to 500 tons per day.

wheels, could unmire the plane and power it to firmer ground with a minimum of effort and time. Automotive-type chains could be used on the wheels to provide maximum traction.

Con Diesel engineers concede that, if much of the plane's belly is also mired down, wheel movers might not be able to do the job.

Another potential customer of wheel movers is Strategic Air Command. Currently-used 40,000-lb. tugs prove inadequate, under certain conditions, to move SAC's 400,000-lb. B-52s. This requires that the tugs be doubled, or even tripled up, to move the giant planes.

OFF THE LINE

Contract to do the interior design, decor and color scheme of the 20 Vickers Vanguards ordered by Trans-Canada Air Lines has been awarded Charles Butler Associates. Butler has been responsible for the interiors of all Vickers Viscounts being operated or on order by TCA in Canada and by Capital Airlines and Continental Air Lines in the U.S. Butler's address: 19 E. 53rd St., New York, N. Y.

Contract to provide technical assistance for aerial camera systems instruction and maintenance has been awarded Hycon Manufacturing Company, Pasadena, Calif. by USAF's Air Materiel Command. Contract covers technical representation with both Strategic and Tactical Air Commands on Hycon's K-36 and K-46 Universal Camera Control System (UCCS) components.

National-Standard Company's stock interest in Poroloy Equipment Inc. has been purchased by Bendix Aviation Corporation. Poroloy Equipment, Van Nuys, Calif., is developer and manufacturer of porous metal filters which are useful in overcoming thermal problems in high temperature hydraulic systems in planes and guided missiles. New metal also shows promise in cooling burner chamber walls and turbine buckets in jet engines to extend their operating life. Company also makes Poromesh, a scintered, stainless steel wire cloth material which can be tailored to aircraft filter applications where heat and pressure are problems.

Millville, N. J.—Leighton Collins of Air Facts drew many loud chuckles from a large audience at the Airwork Operations Symposium with some well-chosen comments about problems of private flyers piloting their planes under IFR conditions. Example: "The Washington tower tells me to check in over the 14th St. bridge—but I don't live there and haven't a clue where it is."

Engineers:

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New positions in

MISSILE SYSTEMS THERMODYNAMICS

Weapon systems activities under Lockheed's management are encountering thermodynamic problems of a most advanced nature. Projects at the Palo Alto and Sunnyvale organizations present unusual scope for achievement in thermodynamics areas including: Boundary layer and heat transfer analyses in hypersonic flow fields such as pressure gradient and real-gas effects; analysis of thermodynamic performance of missiles in continuum flow, slip flow and free-molecular flow; calculation of transient structural and equipment temperatures resulting from aerodynamic heating and radiation; specification of ground tests and flight tests required to verify and improve thermodynamic design of missile and weapon systems; analysis and interpretation of thermodynamic ground test and flight test data. Inquiries are invited. Please address the Research and Development Staff, Sunnyvale 31, California.

Aerothermodynamic Staff members discuss heat flux during reentry of a hypersonic vehicle. Left to right: J. I. Osborne, aerodynamics; R. G. Wilson, thermodynamic research; W. E. Brandt, thermodynamic analysis; Dr. L. H. Wilson, Thermodynamic Section head.

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WHAT'S NEW

Reports Available:

The following reports were sponsored by The Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

Studies of Quantitative Methods for the Separation and Determination of Zirconium and Thorium in Magnesium Alloys—B. A. Raby, Wright Air Development Center, U. S. Air Force, June 1957: $1.75; 61pp.; (PB 131244).

Factors Affecting the Fluidity and Hot Cracking of Magnesium Alloys—H. F. Taylor and M. C. Flemings, Jr., Massachusetts Institute of Technology for Wright Air Development Center, U. S. Air Force, Jan. 1957: $2.50; 93pp.; (PB131045).

Investigation of a New Method for the Determination of the Coefficients of Surface Diffusion of Metals—P. F. Mataich, Horizons, Inc., for Air Force of Scientific Research, Sept. 1956: $1.75; 65pp.; (PB 121956).

The Photometric Determination of Small Amounts of Aluminum in Steel Using 8-Hydroxyquinoline—T. S. Licht and A. J. Frank, Watertown Arsenal, U. S. Army, Nov. 1955: $.50; 18pp.; (PB 131107).

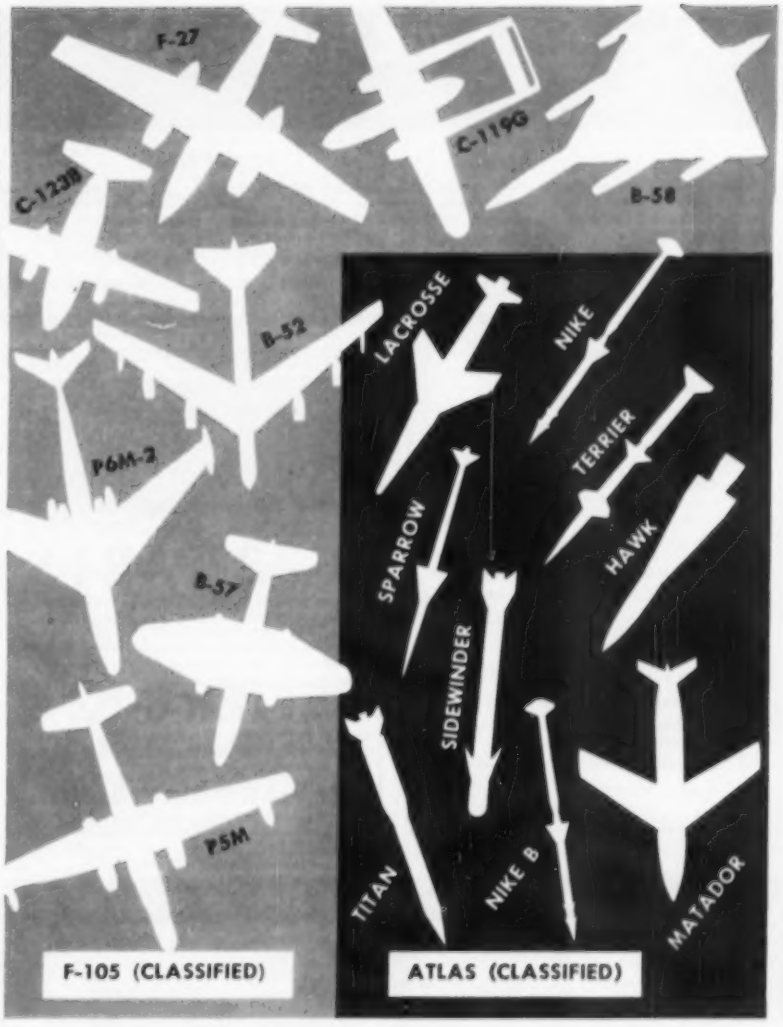
The Determination of Small Amounts of Carbon in Metallic Titanium and Alloys by the Conductometric Method—W. R. Sheehan, Watertown Arsenal, U.S. Army, Aug. 1954: $.50; 11 pp.; (PB 131119).

Theory Design and Engineering Evaluation of Radio-Frequency Shielded Rooms—C. S. Vasaka, U. S. Naval Air Development Center, Aug. 1956: $3.00; 120pp.; (PB L21927).

A Practical Handbook for Location and Prevention of Radio Interference from Overhead Power Lines—U. S. Naval Civil Engineering Research and Evaluation Laboratory, Nov. 1956: $1.25; 48pp.; (PB 131017).

Flight Information Manual of the CAA—Pub. by The Civil Aeronautics Administration: $.50; 88pp.; U. S. Government Printing Office, Washington 25, D. C.

Simulator for Use in Development of Jet Engine Controls—Emile S. Sherrard, Pub. by National Bureau of Standards, U.S. Department of Commerce, Washington 25, D. C.: $.20; 17pp.



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1946. Airwork overhauled low time engines. Past history of excellent maintenance.

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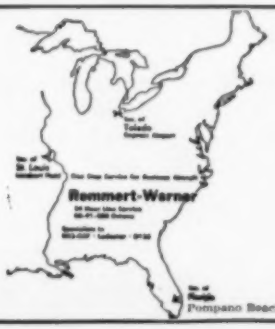

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Low engine and airframe hours. Excellent aircraft for passenger, cargo and agricultural uses.

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We stock, overhaul, and install

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R1830	**R1820**
-75, -92, -94	-202, -56, -72

R985 R1340 R2000

and our most popular DC3 engine
R1830 - SUPER - 92

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1 C-46F
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4000 500 W, 120 V., Mogul 1F lamps ... 4.80 doz.

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MArket 7-3144

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FS-6005, Aviation Week, Class. Adv. Div., P. O. Box 12, N. Y. 36, N. Y.

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Searchlight continued on page 157

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Grumman Gooses

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A new one each month. They are now in various stages of disassembly, overhaul, and conversion at our four conversion centers in St. Louis, Toledo, McBride, and Pompano, and can be completed with many of your own modifications, with choice of engines, radio and electronic equipment, and airframe refinement. On display in St. Louis, Toledo, and Pompano Beach.

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The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

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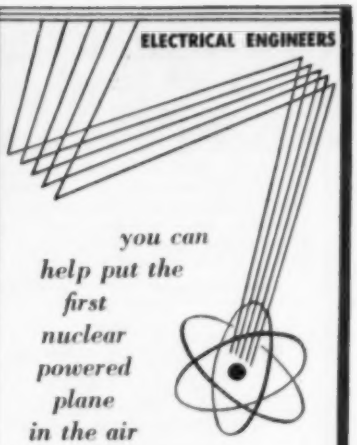

you can help put the first nuclear powered plane in the air

at the AIRCRAFT NUCLEAR PROPULSION DEPARTMENT OF GENERAL ELECTRIC

Think of contributing to one of the most important events in aviation history . . . helping bring out an engine that has unlimited range . . . where fuel can be measured in pounds per day rather than thousands of pounds per hour.

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GENERAL ELECTRIC

ROCHESTER TIMES-UNION
Wed., Sept. 18, 1957

Airlines Rush for Radar

Safety Devices Become Sales Factor

WASHINGTON (IP) — About 40 per cent of the nation's commercial airlines now are equipped with airborne radar—aviation's answer to the thunderstorm menace.

The airlines literally are racing to install these 150-pound boxes of electronic wizardry on their planes. For radar has become a boon to sales as well as safety.

"People are beginning to ask for seats on radar-equipped planes," one high airline official said. "The public is becoming very much aware of what radar can mean to comfort and safety." . . . . . It also shows the paths of least turbulence.

TO PASSENGERS, airborne radar merely means a smoother flight.

But to pilots it means the avoidance of thunderstorm turbulence which has been known to tear a giant airliner apart.

AIRBORNE RADAR SYSTEMS

Specializing IN

Executive Aircraft Installations!

IMMEDIATE RADAR INSTALLATIONS on DC-3's, Lodestars and Super 18's. Finest equipment including: Bendix RDR-1 X & C Band, Collins WP-101 C Band, RCA AVQ-10 C Band, RCA AVQ-50 X Band.

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Phone Wire or Write

SINCE 1937 Page AIRWAYS Inc.

ROCHESTER AIRPORT GENESEE 8-7301 ROCHESTER 11, N.Y.

BUSINESS OPPORTUNITY

Desire active partnership in (or on profit sharing basis) an aircraft radio service. Interested in organizing similar service for distributor. Presently employed as technical representative with commercial and military aircraft experience. BO-6241, Aviation Week.

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Beechcraft D-18S—Five passenger executive interior. Table, lavatory and other extras. Complete dual instrumentation, dual OMNI, 36 channel VHF lear T/R and channel spare receiver. Low frequency receiver and Bendix ADF. Complete deicing equipment. Airframe 1920 hours, left engine 417, right 390. In excellent condition. FS-6318, Aviation Week.

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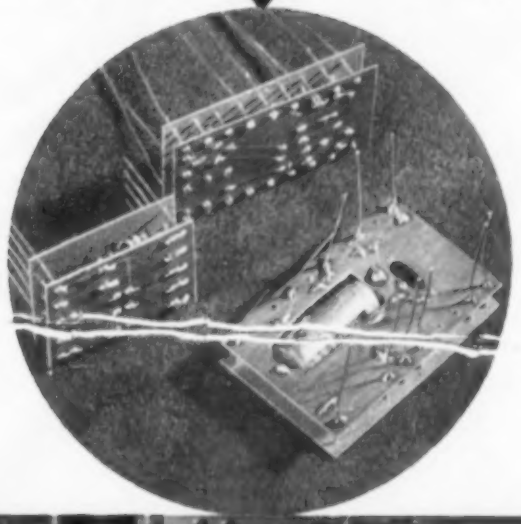

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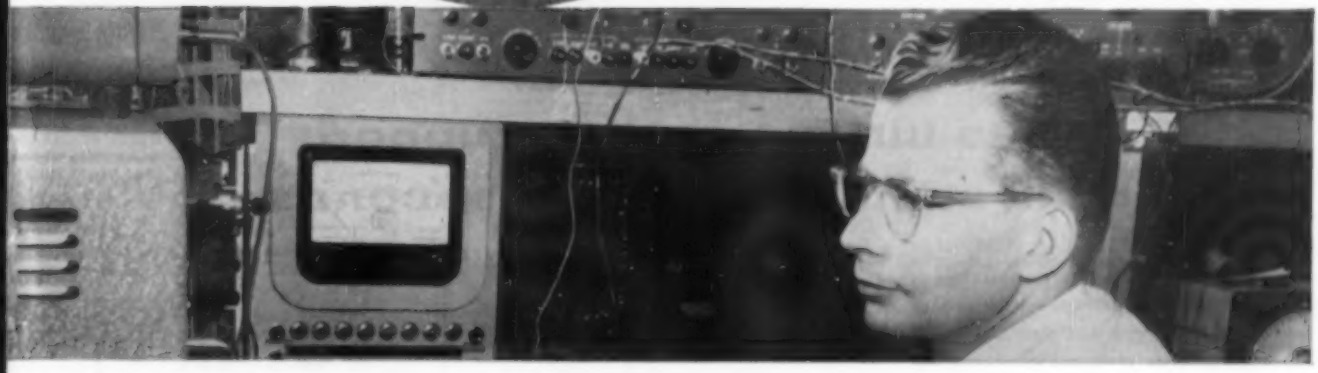

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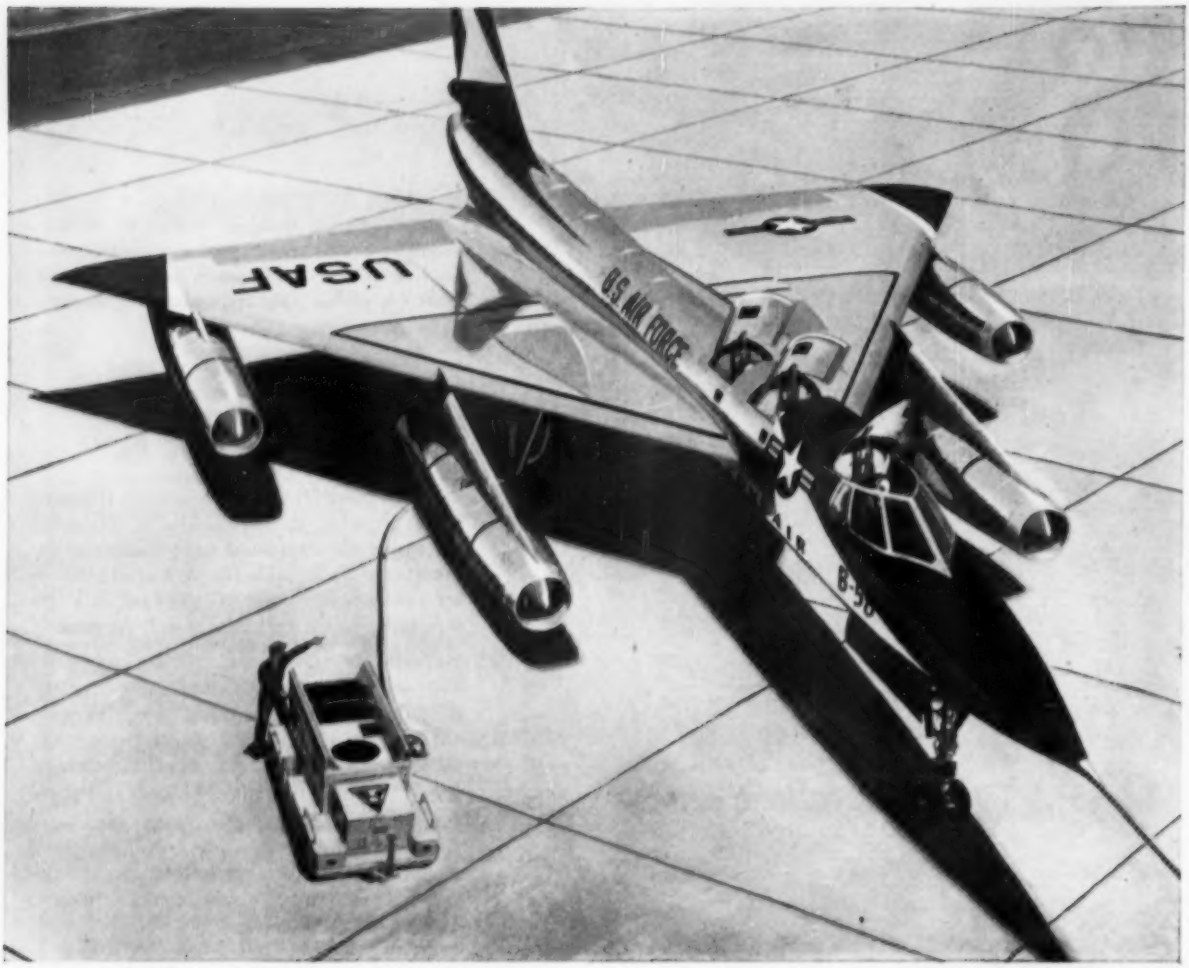

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LETTERS

Manned Satellites

I would like to take this opportunity to congratulate Mr. R. Hotz on his editorial "Missile Misinformation" (AW Sept. 9).

Now, if Mr. Hotz, who has the opportunity, will continue his attack on the "clowns" in Washington and write editorials on coordinating the missile program, then I would have found an ally on this subject.

It is the present ridiculous waste of money which is giving the American people this "phony" prosperity and absolutely no safe defense. All this wasted money should have gone into a coordinated program for the establishment of manned satellites, a far superior defense.

Should we be beaten in the development of manned satellites by Russia we can thank the lying politicians, generals and admirals. Never has there been such an assembly of stupidity in Washington as there is today. We need a coordinated program and less ignorant statements from Washington, D. C.

EDWARD H. TRASKO
West Hartford, Conn.

In Agreement

In reference to "Cockpit Viewpoint" (AW Sept. 9, p. 51), a bouquet to Capt. R. C. Robson and the several manufacturers of Automatic Direction Finders who have recognized the fallacy of ARINC's "three knobs to do the job of one" concept.

Fie on learned committees who seem to consider the crew a pair of long armed apes capable of reaching in all directions at once and looking somewhere else while "keeping the beast right side up." They obviously have never "passed Stroudsburg, Pa., at 20,000 ft. and landed at LaGuardia 15 minutes later."—At least not in the past 10 years.

AVIONIC ENGINEER
Grand Rapids, Mich.

A Bet for Robson

I would like to make several comments on Capt. Robson's observations in the Sept. 9 "Cockpit Viewpoint." Capt. Robson pointed out that the new ADF receivers, recently introduced, add complexity to cockpit procedures at a time when it is all-important to reduce such complexity.

We sincerely believe the Bendix DFA-70 (our nomenclature for the new ADF) does just what Capt. Robson and all other pilots most desire—namely, simplifies the time, complexity and convenience of cockpit procedures. The control head for the new ADF, as specified by Aeronautical Radio, calls for digital frequency selection; digital frequency selection is the technical term for tuning a receiver by a method of switching rather than continuous tuning. Present day VHF equipment is tuned by digital means and this new ADF offers the same advantages over the old system as the present airline VOR receiver offers over continuously tuned VHF receivers.

Also, digital tuning offers much greater legibility; the ¾ in. high numbers of our DFA-70 Control Unit are probably more readable than any other indicator in the cockpit.

Another simplification found in the new ADF receiver is the elimination of the band switch—bandswitching occurs automatically as frequency is selected.

Capt. Robson also indicated that it would take longer to tune the new ADF than the old "coffee grinder." This may seem to be the case on first reflection but, actually, the reverse is true. We ran a time check on a Bendix MN-62 (the old standard airline ADF) and the new DFA-70, both mounted in aircraft. The average time for a pilot to tune from station to station in the aeronautical range band was 3:1 in favor of the DFA-70.

Also, the "resettability" of the DFA-70 is extremely good; in my personal experience, I have found it completely adequate to set the dial to the published frequency in the aeronautical band—fine-tuning is not necessary.

In conclusion, I would like to offer Capt. Robson a flight demonstration of the DFA-70 ADF in any terminal area of his choice; and I would like to bet him a steak dinner that he changes his opinion about the ADF after using it. How about it, Capt.?

RICHARD S. FINKE
Supervisor, Executive Aviation Sales
Bendix Radio Division
Bendix Aviation Corp.
Baltimore, Md.

Disgustion Cure

Referring to the letter "Working Time 30%" from Disgusted Engineer in the July 8 issue, p. 154—it seems to me that if a man spent more time concentrating on what should be done rather than what is actually done he would be less disgusted and further ahead.

E. M. W.
Buffalo, N. Y.

Cooperation Urged

For quite some time I've felt a growing anxiety—changing now to resentment—over the lack of understanding and cooperation between pilots and ATControllers. That feeling was heightened by the Specht incident—particularly with the subsequent CAA and CAB position.

I am not an airline pilot—though I once was. It is not my intention to defend Specht as an end in itself. But I am very concerned over the failure of ATC to render the participants in the incident such protection as was readily available.

On many occasions I've visited ATC centers and towers—and I know they do have their problems. But as often as not, those problems could be considerably lightened by accepting and even inviting pilot cooperation. This is a relatively rare action, now-a-days. Sometimes the resulting confusion reaches ridiculous proportions—and then again—tragic ones.

I come in intimate contact with less seasoned pilots than Specht and his ALPA comrades. Eventually they come to realize that anyone—even ATControllers—can be wrong, and they go about their business with that advantage. But at first—and for some, too long—there is a tendency among neophytes to regard all CAA dictums as unimpeachable. Any experienced pilot will readily agree that there are times when ATC or other CAA controls are unworkable or unsafe—and there are others when he goes along with borderline ones hoping nobody will suffer. But the beginner hasn't the background with which to distinguish the good and the bad. Therefore, CAA should exercise every effort to protect them—instead of itself.

ALLEN W. HAYES
Owner-Chartair
East Hill Airport
Ithaca, N. Y.

He's Right

On p. 85 of the Sept. 9 issue, AVIATION WEEK identified a B-50 refueling two F-100s and a B-56. I would like to say that your identification of the B-56 was wrong. It is a B-66.

DENNIS HAMLIN
North Hollywood, Calif.

(It was a B-66!!—Ed.)

Pilot Backs Specht

I read with great interest your presentation of the findings and rebuttal of the Specht case (AW March 18, p. 30). Having experienced the discomfort associated with such events myself, more than once, I throw my lot with Specht.

The overriding point of this matter is easily lost among all the words, both written and spoken, that are associated with the second-guessing that will always occur. The point is, who is in command of an airplane in flight, the pilot or someone, anyone, else? The answer is obvious.

If a pilot abuses his emergency powers, he should be relieved permanently, provided his misdeed is established by legitimate means. However, the burden of proof is never on him, and in case of reasonable doubt, nobody else, especially a non-pilot, is qualified to pass judgment. And at the moment the emergency is declared, not a solitary soul can presume to give less than immediate, full, constructive cooperation with every means at hand, regardless of personal feelings, voice inflections, etc.

I have the greatest respect and admiration for ground control personnel, and I cooperate with them to the fullest. But the guy who's driving the bird is the guy with the wheel in his little hot hands, never anyone else. To question this is folly, to ignore it, fatal.

CAPT. WILLIAM F. MILLER, USAF
Wright-Patterson AFB, Ohio

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